



# An impact study of COVID-19 on six different industries: Automobile, energy and power, agriculture, education, travel and tourism and consumer electronics

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## Abstract

The recent outbreak of a novel coronavirus, named COVID-19 by the World Health Organization (WHO) has pushed the global economy and humanity into a disaster. In their attempt to control this pandemic, the governments of all the countries have imposed a nationwide lockdown. Although the lockdown may have assisted in limiting the spread of the disease, it has brutally affected the country, unsettling complete value-chains of most important industries. The impact of the COVID-19 is devastating on the economy. Therefore, this study has reported about the impact of COVID-19 epidemic on various industrial sectors. In this regard, the authors have chosen six different industrial sectors such as automobile, energy and power, agriculture, education, travel and tourism and consumer electronics, and so on. This study will be helpful for the policymakers and government authorities to take necessary measures, strategies and economic policies to overcome the challenges encountered in different sectors due to the present pandemic.

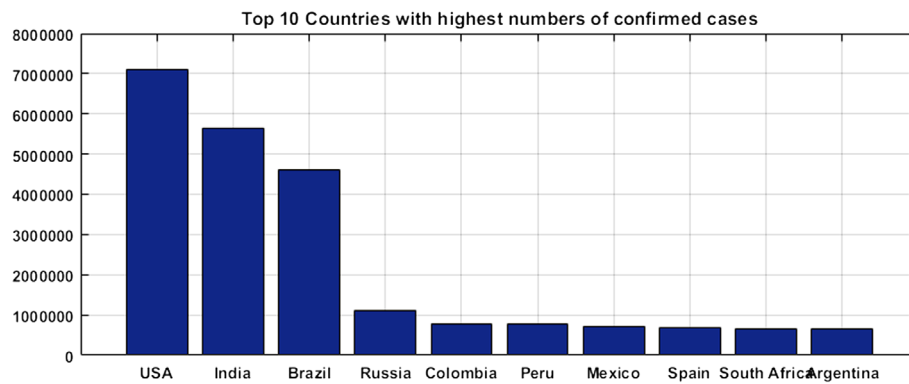
## KEYWORDS

agriculture, automobile, consumer electronics energy and power, COVID-19, education, industry, pandemic, travel and tourism, WHO

## 1 | INTRODUCTION

In the city of Wuhan, South China, numbers of unidentified pneumonia cases were reported in the last week of December 2019. The Centers for Disease Control (CDC) has declared the unknown pneumonia as novel coronavirus pneumonia on 7 January 2020 (Lu et al., 2020). Later, novel coronavirus pneumonia was renamed as SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2) by the International Committee on Taxonomy of Viruses (Huang et al., 2020; Lai et al., 2020). On 11 February 2020 the disease was declared as COVID-19 by the World Health Organization (WHO, 2020). The WHO asserted the outbreak of COVID-19 as pandemic on 11 March 2020 as the number of cases other than the China escalated more than two million in different regions of the world. The number of new cases being reported within China, where the virus first appeared, is declining sharply, while the number of new cases outside of China continues to climb. As of 22 September 2020, there have been 31,507,723 confirmed cases of COVID-19 worldwide, with 969,812 confirmed deaths. In the United States and India, where tests are now being administered more frequently, the number of confirmed cases is rising exponentially. Figure 1 depicts the top 10 countries in the world having highest number of confirmed cases as on 3 August 2020.

The outbreak of COVID-19 pandemic, which is labelled as black swan event (Burch et al., 2016), has not only caused an adverse impact on the health of the people all over the world but also effected the socio-economic activities of the countries all over the world. To flatten the curve of pandemic, the governments of almost 162 countries have announced strict shutdown of national and international borders, travel restrictions



**FIGURE 1** Top 10 countries with highest number of confirmed cases

and lockdown measures (<https://www.aljazeera.com/news/2020/03/coronavirus-travel-restrictions-border-shutdowns-country-200318091505922.html>). Therefore, the markets of the world's largest economic countries and others are operating in a fear of disruption of global financial markets. The major areas such as global supply chains, trade, agriculture industry, automotive industry, electronic industry, travel, transportation and tourism industry, and so on have been severely disrupted because of the outbreak of COVID-19. The economy of various other sectors such as aviation industry, entertainment industry, sports industry, and so on has also been severely hampered all over the world due to lockdown. In India, first case was reported in the last week of January 2020. The number of confirmed COVID-19 cases started escalating from the second week of March 2020. As India is a developing country, the health system will be demolished if the number of cases increases exponentially. Therefore, to inhibit the spread of the coronavirus, the government of India has announced strict 3 week lockdown from 25 March 2020. Due to the lockdown, a large number of migrant workers all over the country left with no job or income. As all the activities in the country have been interrupted rigidly, a serious disruption has encountered in the supply chain mechanism of all the sectors. This unplanned and unusual lockdown is also having serious effect on the country economy which is already on downward trajectory since the financial year of 2018–2019. Therefore, it is necessary to report the impact of this pandemic on different industrial sectors. This will be helpful for the policymakers and government authorities to take necessary measures, strategies and economic policies to overcome the challenges encountered in different sectors due to the present pandemic.

In this paper, the effect of COVID-19 on six different major affected sectors such as automobile, power and energy, electronics, travel, tourism and transportation, agriculture and education have been emphasized. We also emphasized on the analysis of issues and challenges encountered in these sectors by projecting how the changes in the economy has occurred in these sectors due to the COVID-19. Further, it is also specified the strategies taken by the government to provide support to the life of the migrant workers and to overcome the recession encountered in different sectors.

The rest of the paper is standardized in the following way. Section 2 illustrates the impact of COVID-19 on the areas of the automobile industry. It also focuses on the various issues and challenges in the automobile industries and strategies taken to overcome these challenges. The consequences of COVID-19 on Power and Energy sector and the measures taken by the policy makers to overcome the imbalance encountered in this sector has been illustrated in Section 3. The COVID-19 effect on the consumer electronics and in the supply chain of electronics has been described in Section 4. Section 5 describes how the COVID-19 impacts the public transportation, travel and tourism sector. The effect of COVID-19 on various sectors of the agriculture and measures taken to meet the challenges encountered in the pandemic has been explained in Section 6. The impact of COVID-19 on sectors and sub sectors of the education system and the measures taken by the universities of different countries and Indian education system to meet the challenges occurred in education system has been presented in Section 7. Section 8 explains about the impact of COVID-19 on publishing sector. Section 9 explains the critical analysis of COVID-19 effect on the economy of different sectors. It also describes the analysis of other sectors that have been affected due to the pandemic of COVID-19. It also provides an overview of impact of COVID-19 on the GDP (gross domestic product) of Indian economy and the unemployment problem. Finally, the conclusion of the paper has been described in Section 10.

## 2 | IMPACT OF COVID-19 IN AUTOMOBILE INDUSTRY

The COVID-19 epidemic has pushed the global economy and humanity into a disaster. In the attempt to control this pandemic, the governments of all the countries have imposed a nationwide lockdown. Although the lockdown may have assisted in limiting the spread of the disease, it has

brutally affected the country, unsettling complete value-chains of most important industries. The epidemic is having a foremost impact on all features of industries which includes the automobile sector, with key manufactures either completely close following the orders passed by local governments or running an organization with least staff at manufacture units to remain their personnel secure. Over the last 12–18 months, the automobile field had already undergone significant delay due to structural modification openings with the goods and services tax, axle-load reforms, shift to shared mobility, liquidity crunch, and so on industries had faced major effect and has roughly been at a complete idle since 24 March due to the COVID-19's lockdown. Extended truncation of customer demand due to the lockdown is observed drastically distressing auto manufacturers. The majority of the companies are starving the support of R&D (Research and development) to maintain core functions and potentially getting back the growth made on mobility technologies as well as alternate fuels.

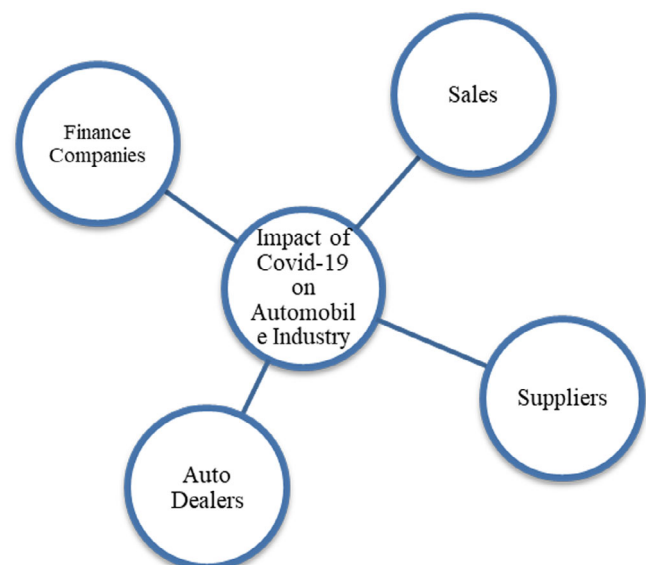
Some research literatures have explained the consequences of the COVID-19 on the automobile industry. Rajamohan et al. (2020) has conducted a study on how the stock market particularly the National Stock Exchange of automobile sector has been distressed due to COVID-19. The results reveal that higher value equities have been sold at depreciation value. Moreover, lower returns have been reported for the returns of the automobile sector index. Hence, from the results it can be concluded that COVID-19 pandemic has created a significant effect on the stock exchange of the automobile industry. A hybrid model named as SEM-Logit model was proposed by Yan et al. (2020) to explore the consumer decision making as well as the factors affecting the purchase of automobile during pandemic. The proposed model was used to investigate the effect of social-demographics, epidemic-related and psychological latent variables on the purchase decision making process of the automobiles. The results reveal that pandemic has generated an adverse effect on the purchase of the automobiles. The factors such as household income, travel vulnerabilities and epidemic severity in local regions have influenced the purchase decision making process of individuals. Further, study is used to assist the policy makers in implementing significant measures to overcome the present crisis in the automobile purchase.

## 2.1 | Area under automobile industry and the COVID-19 impact

The impact of COVID-19 has affected several fields and some of them are mentioned in Figure 2.

### 2.1.1 | Auto dealers

Auto dealers have faced major problems. There are presently 15,000 above auto dealers which include two, three, and four wheelers across India. They were not able to transport vehicles for the lockdown period. Auto dealers have informed 30–45 days of completed goods record, likely to be greatly low-priced prior to post lockdown. In the next 6 months, it is predictable that there will be finishing off at least 8%–10% of these dealerships.



**FIGURE 2** Impact on automobile industry fields due to COVID-19

### 2.1.2 | Auto suppliers

Auto suppliers have a high reliance on immigrant labour, whose absence is anticipated to additional delay restoration post lockdown, ensuing in a domino consequence on the complete assessment chain. Suppliers are facing the challenges of liquidity that may yield to fading market circumstances, causing extensive trouble across the whole manufacturing network.

### 2.1.3 | Finance companies

These financial companies are likely to face the burden, since loan evasions are expected to increase, and new loans are likely to fall, given complexities in deciding customers' credit value. The impact of the COVID-19 is expected to put tension on used-cars, mobility solutions, and after-market service suppliers, whose financial support relays on violent growth projections.

### 2.1.4 | Sales

COVID-19 affected automobile new vehicle sales very badly especially in the month of February 2020. Like, in China new sales of vehicles have fallen by 92% in February. Also, in European countries total vehicle sales were dropped by 7.4% when compared to that of sales in last year. Also, in country like India, many automobile industries such as TVS, Mahindra have stopped their production sales due to lockdown and likewise many sectors have been affected.

## 2.2 | Issues of the automotive sector due to COVID-19

The automotive sector is on the front line due to the interrupt caused by the epidemic to trade as usual and throws the financial position into indecision. A few major affected areas are home and key manufacturing hubs to foremost links in the total supply chain sectors. Distinctive emergency plans helped allowing functional effectiveness by following measures like power outages, cyber incidents, and natural disasters, and so on. The situation is mobbing fastly due to the widespread effects. The key areas of these issues include crisis handling and response, workforce, supply chain, finance and liquidity, tax and trade, and strategy.

### 2.2.1 | Crisis management and response

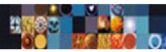
Cautious circumstances planning are vital. The change in the epidemic's epicentre to North America and Europe highlights the necessity for automotive companies to stay living in their responses to the disaster. Companies not only should consider the impact of the epidemic across a variety of critical fields but also should acquire the explosive economic, strategy, and financial market terrain into account.

### 2.2.2 | Workforce

As per the Bureau of Labor Statistics, Automakers and their suppliers have used more than one million people in the United States. This welfare of employees should be the major concern for corporate leaders. If the pandemic widens and a huge percentage of the employees get sick, it could severely reduce the capability of the manufacture. So, clear, apparent, and appropriate communications to workers are vital, predominantly when the number of detailed cases spikes due to enhanced access to testing.

### 2.2.3 | Operations and supply chain

The impact of COVID-19 on the supply chain of automotive may be considerable. Some countries such as Japan, China, and South Korea that have seriously been affected by the spread of this virus, accounted for a major share of inclusive auto manufacturing. Automakers with overall supply chains are expected to observe two tier as well as three tier dealers who are mostly affected by epidemic related disturbances. Some steps are considering enhancing lines of communication and chain visibility to identify the potential problems better in early and work on remediation plans.



## 2.2.4 | Finance and liquidity

The quick exploitation of the COVID-19 epidemic has corresponded with the final weeks of the initial quarter. For companies in Spain, Italy, and France which are in dominant regions has led to functional disturbances that deferred their capability to conclude financial statements. Moreover, a few automotive companies are gradually more distressed about the prospect that the financial impact of the epidemic may generate triggering actions for the recoverability of receivables, reform events, long-lasting quality impairments, and liquidity issues. Condensed productivity of the funding team could create a substantial rise in the amount of work to be acquired through in the imminent weeks. The majority of the suppliers, as well as multinational companies, should cautiously consider their money, liquidity, and operational capital policies in light of the epidemic's impact on the world and credit markets.

## 2.2.5 | Strategy

The epidemic of COVID-19 along with the resultant economic ambiguity may expect reduced customer requirements in the short term, probably leading to dampened sales of a new vehicle as well as delayed payments on additional maintenance. The interruption of the automobile supply chain may entrap cash that might be utilized to present employee relief and support functions. Because of the reasons, intent cash might be inactive in the market for an extensive era of time, new strategies can be arranged to assist in alleviating the sliding impact.

Moreover, many challenges (Accenture, 2020) part from the above mentioned strategies have been mentioned in Table 1.

## 3 | IMPACT ON POWER AND ENERGY INDUSTRY

The COVID-19 pandemic has been continuously affecting the energy sectors like other aspect of life. Maintaining the continuity of power flow to different industry needs as well as satisfying the need of consumers viewpoint during the COVID-19 crises is a severe challenge for the power and utility companies (Mylenka, 2020). The protection and distance protocols have forced for the reduction of worker in this sector; additionally, the necessities of strict hygiene have a direct effect on the field worker and operation. Moreover, the decreased demand has made its own technical challenges where the system engineers taking to achieve the supply voltage as well as reactive levels to duck the risk such as reactive shut-downs at distribution levels. Therefore, the power utility company should ensure some advanced strategies for the sudden decision making. So, it

**TABLE 1** Various challenges of auto-mobile industry

Challenge	Present scenario	Future scenario
Supply	<ul style="list-style-type: none"> <li>Worldwide auto production is robustly depending on China</li> <li>Supply deficiency is distressing gathering of all auto industries in Europe and Asia</li> <li>Almost two third of auto manufacture was affected directly in china due to the stopping of suppliers</li> <li>Ocean transporters have cancelled major ways due to no proper deliveries</li> </ul>	<ul style="list-style-type: none"> <li>Recovery of auto traders acquires time, even with the scenario of multiple traders in several factors like workforce availability, safety parts and regulation, and so on</li> <li>The restart will be difficult, cost exhaustive and will acquire time due to the requirement of synchronize production all over the supply chain</li> <li>Elasticity of production will be amplified to transfer the production from one to another plant</li> </ul>
Manufacturing	<ul style="list-style-type: none"> <li>Auto manufactures had stopped their productions in china, North America as well as in Europe</li> <li>A company of An American electric vehicle was enforced to stop their factory</li> <li>Most of the auto manufactures has declared an overtime reduction, short-time labour, and so on for chosen managerial departments</li> </ul>	<ul style="list-style-type: none"> <li>The whole impact of manufacturing stoppages due to filing demand, confronts with components supply, and employee's safety will have a foremost financial impact in the short to intermediate run</li> <li>Stoppage of manufacturing services in Europe is likely to distress 14 million employments</li> </ul>
Working capital and liquidity	<ul style="list-style-type: none"> <li>Rate of Cash burn in the trade is currently fewer than 2 months</li> <li>Many industries are negotiating superior credit lines with their depositories to endure the crisis</li> </ul>	<ul style="list-style-type: none"> <li>Major auto manufactures will expected to face the problems of liquidity as functioning cash flow reduces during the disaster</li> </ul>
Vehicle sales	<ul style="list-style-type: none"> <li>Total, sales of automotive light vehicle (LV) have fallen</li> <li>China which is the first most country affected by the COVID-19 had experienced a huge fall in sales with less than 80% in February</li> </ul>	<ul style="list-style-type: none"> <li>Sales in China are expected to fall by more than 10% in the year 2020</li> <li>Sales in USA are anticipated to refuse by 15% in the year 2020</li> <li>Sales in Western Europe are likely to reject by 14% in the year 2020, respectively</li> </ul>

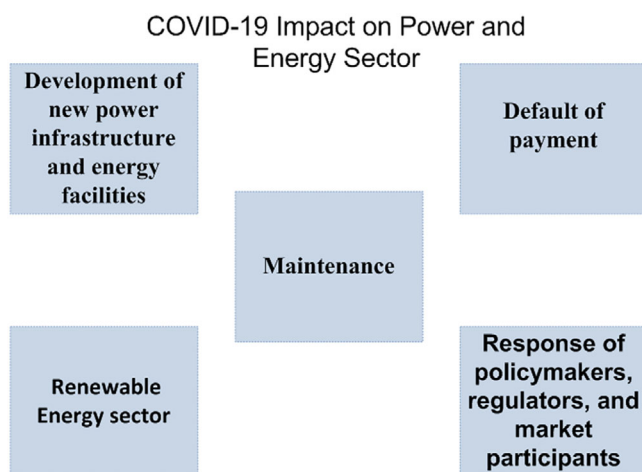
is essential for the utility companies and the governments to work coordinately to regulate the power supply affordably, sustainably and securely. One study shows that Power and energy industry has been harmfully impacted. In Italy 20% reduction in demand and values are being witnessed. In India, presently power demand has decreased by 25%–30% (Khanna, 2020).

The following are the few literatures that present how the power sector has been affected because of the present pandemic. An analysis hourly demand of electricity for the province of Ontario was performed by Abu-Rayash and Dincer (2020) to determine the effect of the COVID-19 pandemic on the dynamics of the energy sector. The analysis shows that in the month of April, there is a decline of 14% in the overall electricity demand of the province. Mostly, huge reductions in the daily demands of electricity was noticed on weekends. Further, the analysis of hourly electricity demands displays a clear flattening curve specifically in the peak hours of morning and evening, that is, between 7 AM to 11 AM and 5 PM to 7 PM at the time of pandemic. Moreover, the reduction in the GHG emissions by 40,000 tonnes of CO<sub>2e</sub> in the month of April results in the savings of \$131,844. Finally, this analysis serves to devise the changes in the lifestyle options and choices in the short-term and long-term future electricity demands. An assessment of the power system scenarios implemented globally together with the socio-economic and technical consequences because of lockdown have been scrutinized by Senthilkumar et al. (2020). It has been noticed from the primary analysis that because of the lockdown there was a drop in the demand of the commercial load while the demand for residential load expanded to the maximum. Further, this study examined distinct issues and challenges experienced by various utilities of the power system in India. Moreover, the actions implemented by the power sector for smooth running of the power system in India was also presented in the study. Lastly, this study presents a set of suggestions that may assist the government authorities and policymakers all over the world to cope up with the present and future unpredicted crisis in the power system. Zhong et al. (2020) have presented an analytical study on the effect of COVID-19 pandemic on the power sector. Initially, an analysis of the electricity demand and supply has been performed due to the reduction in total electricity consumption because of the lockdown restrictions in different regions of the country. From the analysis, it has been noticed that the contribution of renewable energy has been raised against the reduction of the power generation. Further, an analysis of the challenges to be faced in the operation and control of power system has been presented due to the enhanced uncertainty of load, altered power balance and issues of voltage violation. Next, an investigation of market price performance has been carried out to cope up the challenges of the deterioration of electricity prices in major markets and financial problems. Finally, the external factors occurred due to pandemic such as diminished emissions and recovery of environmental conditions temporarily has been explained. Aruga et al. (2020) have suggested an autoregressive distributed lag (ARDL) model to analyse the consequences of COVID-19 pandemic on energy consumption in India during the lockdown. The proposed model was basically used to determine whether the COVID-19 infection produces a positive impact on consumption of energy during lockdown period and whether this positive impact remains same or vary among distinct average income levels. From the analysis, it is noticed that higher income levels have a quick restore from COVID-19 crisis when compared with poor income regions such as Eastern and North-Eastern part. Further, this study recommends the significance of implementing special economic aid and measures for the poorer income regions to overcome the damage during COVID-19 crisis and to restore their energy consumption levels to the levels prior to COVID-19 crisis.

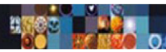
In general, the effect of the current COVID-19 virus on the power sector can be studied through Figure 3 with the following sub-section.

### 3.1 | Development of new power infrastructure and energy facilities

The ‘Expanding the infrastructure’ is very common to each and every industry, and the energy industry is one of them. However, as the impact of pandemic is spread all over the world, the source of capital investment has been highly affected, and therefore, many power companies have



**FIGURE 3** Impacted area of power and energy sector of COVID-19



decided to stop or reduce their capital outflow where possible. For example, DSOs (the 'Distribution System Operator', whose role is to transform the power sector to make it more flexible, reduced the load on the network through penetrating new renewable sources, leverage data to increase re-penetration) are postponing the majority of opened projects, due to a significant reduction in the purchasing of goods and services. Moreover, the less-critical investments have been postponed. Therefore, the accomplishment of investment schedules by transmission system operators (TSOs) and DSOs is similar in jeopardy (Mylenka, 2020).

### 3.2 | Default of payment

The defaulters of bill payment have been increasing with a cascaded manner. In many countries, the customers have been informed by their respective energy regulators and government authorities to prolong the payment of energy utility bills. Even if there is extensive lenience of non-payment by end-users, legislators did not openly describe if indulgence regarding disbursement would be approved further along with the supply-chain'. Up to now, not a single official of the Energy Community have clearly sharp who will endure the outlays of sponsoring this debit. The waiving of interest, lockdown and prohibitions on cutting off will most likely enhance costs for DSOs. In addition to this, their profits will be reduced and, if the disaster remains, their economic position will be worsened. As a result, the negative impact of cash flow and short-term liquidity of DSOs will be unavoidable. If the situation persists than the maintenance cost for regular operation will also be affected within a couple of months (Mylenka, 2020).

### 3.3 | Impact on renewable energy sector

The renewable energy sector is currently the heart of power and energy industry. This sector has been badly affected due to the current pandemic. For example, India imports approximately 80% of its solar-photovoltaic (SPV) cells necessity from the China. In this regards, Indian companies are facing indecisively concerning the receiving of SPV panels from China. Moreover, India imports other clean energy equipment's such as wind turbines and batteries from China and Europe. The delay in supply of these clean energy utensils ahead of the existing inventory with the productions is impacting well-timed completion of renewable energy project give rise to in adverse situation. India single-handedly 3000 MW of SPV and wind energy projects encounter suspensions, owing to the CVID-19 lockdown. Moreover, the planet's top manufacturer of rechargeable batteries was incompetent to accomplish the experiments of new-fangled prototypes of rechargeable batteries because of the COVID-19, and this has led to a deduction in the supply capacities of rechargeable batteries for the European market (Khanna, 2020).

### 3.4 | Maintenance

Maintenance of energy and power sector is being too difficult in this pandemic situation, as the systematic maintenance deeds and field-worker/technicians are constrained to a least, with mended and restoration being prioritized. Portable mediation crews have been started as a standby for field workers. The QoS, in spite of this, may be at danger if scheduled cares and maintenance facility are suspended for too long. However, a few documents have analysed that the availability of vital parts, tools, and equipment used for the maintenance workers are not a worry situation in the current timing, but there is a peril to network and staff safety if supplies are not restored in time.

### 3.5 | Response of policymakers, regulators, and market participants

Role of policy-makers and energy regulators have to ensure the energy security in this pandemic period. They need to address all the challenges associated to provide all the necessary services reliably. For instance, Europe's energy regulators have taken some exceptional actions to guarantee a secure and consistent energy supply by assuring vital amenity (e.g., gas, heating and power). In addition to this, they have taken some measures intended to ease financial needs of customers who face monetary difficulties during lock-down (Mylenka, 2020). Some other countries have also taken several measures to backing the renewable energy sectors. For example, Poland's administration has formed an act named as Anti-Crisis Shield Act, which offers the President of the Energy Regulatory Authority with the right to increase time limit for renewable energy manufacturers for initiation of trades inside the auction system.

Similarly, the DSOs have employed numerous administrative actions associated with the security of workforces, guaranteeing maintenance deeds, acquiring supplies, and so on. The safety and security of report centres is safeguarded through: (i) remote units in report centres with sufficient back-up squads on stand-by; (ii) limited admission to report centres and to stand-by parts; (iii) engaging the retired staff as standby units owing to decrease the load on key staff.



## 4 | IMPACT ON COVID-19 ON ELECTRONICS INDUSTRY

Like other industrial sectors, the effect of COVID-19 on electronic industry (EI) is also analysed in this study through this section. The EI has affected in several ways like: (i) Increasing counterfeit trickling, (ii) shipping delays, (iii) consumer behaviour and (iv) environmental viewpoints. The taxonomy of EI can be explained by its types of products, such as smartphones and tablets, desktops/laptops/notebooks, televisions, cameras and camcorders, audio/video devices, gaming consoles and accessories, home appliances, and others. Other product type includes wearable electronics such as smart watches, virtual reality and augmented reality gears. The market of EI has spread into North America, Europe, Asia-Pacific, and the rest of the World. However, the major market share in the global consumer electronics market is upheld by Asia (especially China). The companies such as Samsung, Panasonic, Sony, Huawei, Hitachi, and several others are the EI based companies that shaping the market growth.

### 4.1 | Supply delay

The manufacturers of EI's have gone through a shipment delay of at least 5 weeks from the suppliers owing to the pandemic. This data is associated by a survey carried out by IPC, a global manufacturing association. The survey also highlights the negative impacts on manufactures as a result of shipping delays from China and other leading suppliers. Although, the suppliers are giving some encouraging words regarding of decreasing of delays, 'The delays will likely have ripple effects for the rest of the year', said John Mitchell, IPC's president and CEO. As the virus is spread all over the world, the supply chain is going to face more and varied pressures and disruptions (<https://www.engineerlive.com/content/what-covid-19-doing-electronics-industry>).

### 4.2 | Counterfeit trickling

Counterfeit factors have a huge negative impact to the consumer electronics sector. In last few years, the counterfeit sectors have shown an increasing curve which affects authorized producers manufacturing the genuine modules. Therefore, the necessity of proper inspections towards the verification of authentication and genuinely of electronic product is demanded for the suppliers and manufacturers of electronic modules. In this pandemic period, the counterfeit factor in electronic industry sector has activated to obtain higher profit margin. Therefore, filtering the counterfeit issue is becoming a challenging task for the industry during the COVID-19 outbreak (<https://www.researchandmarkets.com/reports/5013558/impact-of-covid-19-on-the-consumer-electronics>).

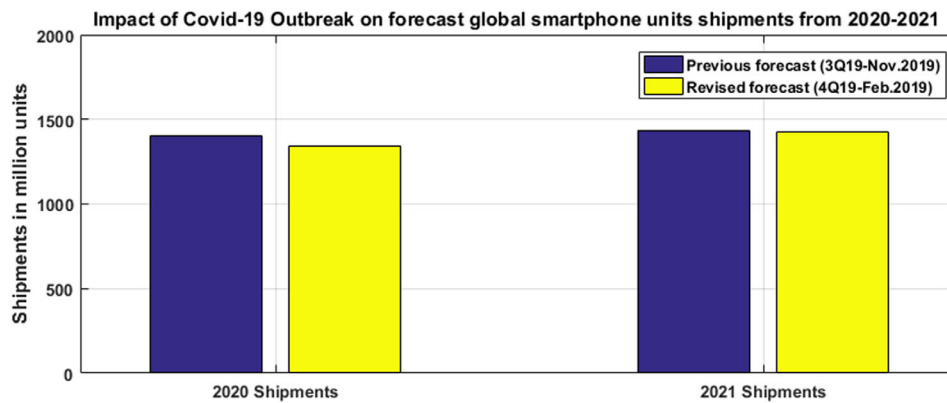
### 4.3 | Consumer electronics

The impact COVID-19 virus spreading is found to a positive for some companies for over a 12 month period and negative for several other companies. Some survey have reported that the consume electronics are likely to be the most affected industry of COVID-19 outbreak just like industrial and automotive. These areas are likely to be influenced more than other commerce owing to their resilient engineering capability in China and supply-chains that depend mostly on China, Europe and USA. However, the medical, defence, aerospace based electronic manufacturing units are thought to be the least impacted sectors. This is due to less dependency and the ratio of supply and demand. In the case of geographical region, the electronic market has been analysed into North America, Europe, Asia-Pacific, and the rest of the World. Asia-Pacific has probably contributed a major marketplace share in the global consumer electronic market. Fast development, growing disposable income of people and existence of numerous significant bazaar performers such as Samsung, Panasonic, Sony, Huawei, Hitachi, and several others are influencing the market growth of the region. Out of these major companies in the consumer electronics sector to get affected due to COVID-19 include Apple Inc., Canon Inc., GoPro Inc., Hitachi Ltd., Huawei Technologies Co. Ltd., LG Electronics Inc., Nikon Corp., Panasonic Corp., Samsung Electronics Co., Ltd., Toshiba Corp., and several others. Apple is one crucial consumer electronics seller that has been affected. More than 90% of Apple's products are made in China and the Chinese marketplace accounts for 18% of its revenues (<https://www.researchandmarkets.com/reports/5013558/impact-of-covid-19-on-the-consumer-electronics>).

### 4.4 | Smartphone industry

Currently, smartphone is one of the most popular products of consumer electronics. In term of supply-chain and demand, it is also impacted adversely due to the virus spread. Figure 4 shows a bar-graph plotted to explain the demand of Smartphone that expected earlier and the current situation (<https://www.statista.com/statistics/1106020/forecast-of-annual-global-smartphone-shipment-impacted-by-covid-19/>). A number of





**FIGURE 4** Analysis of the forecast of global smartphone unit shipments from 2020 to 2021 (in millions)

authorities are forecasting that the COVID-19 outbreak will have a diverse impression on the development of 5G plans, which were commencing to gain traction in the global market. Interruptions in manufacturing and reduced demand will set back the development of affordable 5G phones, which are necessary to encourage large-scale adoption of the technology. As demand for all smartphones decreases, 5G devices will have difficulty in finding a foothold.

However, following are few facts that show the use of smartphone during the Pandemic as a positive thought (<https://apnews.com/Business%20Wire/c2fbf35eab3849a8be2a66b1f34190e6>, <https://blog.technavio.com/blog/covid-19-smartphone-industry>).

- The smartphone industry and governments are working together on COVID-19 contact-tracing which is a good side of the use of the consumer electronics product. Apple and Google are both strong proponents of decentralized contact-tracing apps, which protect users' privacy by keeping as much data as possible on users' phones rather than in a government-controlled server.
- Researchers develop smartphone-based COVID-19 test. Pharmaceutical company Sanofi and Silicon Valley startup Luminosities are evolving a test for the virus that can be used with any brand of smartphone. It comprises an add-on that plugs into the phone and an app that performs the test and reports the results. The test device attaches to the phone's camera and flash and contains chemicals that glow in the dark when the virus is present.
- App uses smartphone computing power to search for coronavirus treatments.

## 5 | IMPACT OF COVID-19 ON TRAVEL, TOURISM AND TRANSPORT INDUSTRY

Travel, tourism and transportation (TTT) are few most critically victimized sectors of COVID-19. As the rickshaw puller to airlines, all have been affected simultaneously by this virus spread; the demand of TTT sector is adversely hit. However, it can be also observed that the demand of truck transport has increased to some extent owing to transport some essential goods. For example, in US the increased product (40%–60%) is moved to grocery stores and warehouses since the spread of COVID-19 (<https://wwwmt.com/news/local/covid-19-puts-truck-drivers-in-high-demand-for-transport-of-crucial-goods>).

The permutation and combination of guidelines/rules varying from social-distancing to lockdowns/shutdowns of cities is likely to slow-down or even entirely ban manufacture and expenditure events for an indeterminate time-period, and thereby leading to trades in retail and hospitality sectors to close. Several countries have imposed the lockdowns in their most affected states and even closed their borders as an action to decrease the spreading of the COVID-19 virus. Therefore, each country has seen a sharped decrease of demand of transport industry. In this section, we have presented a brief analysis of COVID-19 breakout impact on the public transport and its consequent impact on travel and tourism sectors (Chauhan, 2020).

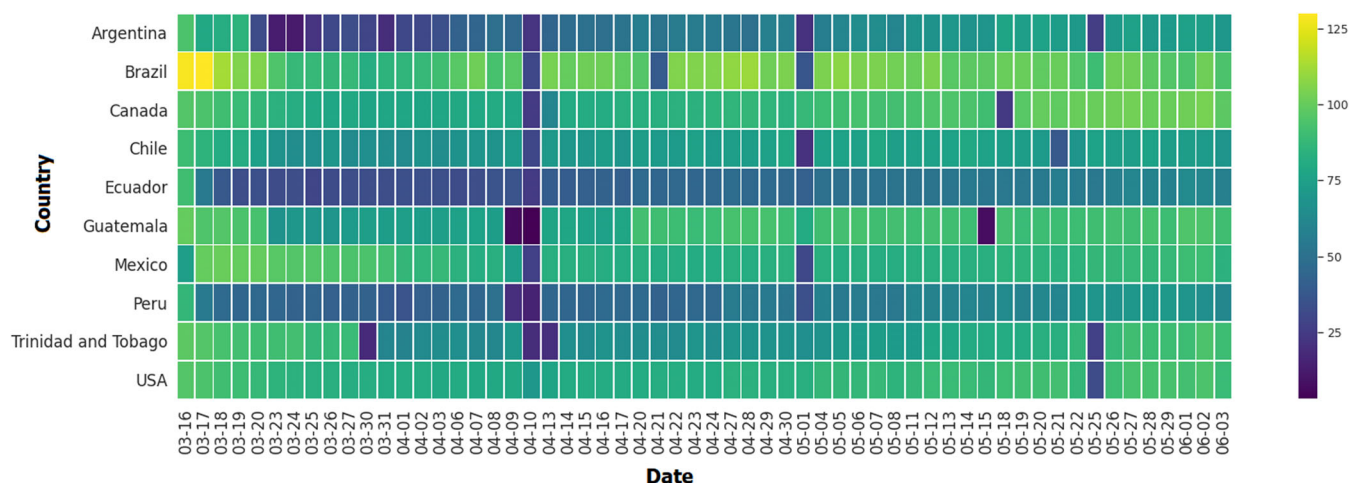
Some literature reviews on the effect of COVID-19 infection on the travel and tourism sector has been presented. An overview of the present COVID-19 pandemic on tourism has been projected by Gössling et al. (2020) by making an assessment of the previous pandemics and other global crisis. Initially, a rapid analysis of COVID-19 impact on the worldwide tourism up to the end of March 2020 has been represented by considering travel restrictions and reduction in the airline services. Next, the effect of distinct regions and suggestions for the development of tourism has been discussed. Finally, to provide more feasible tourism sector in post pandemic this paper highlights some implications for future tourism. To assess the effect of travel restrictions at national and international level on the spread of pandemic, a global metapopulation disease transmission model was suggested by Chinazzi et al. (2020). The proposed model uses internationally reported cases to measure the impact of travel restrictions. It shows that the overall progression of the epidemic is delayed by only 3–5 days in the mainland of China due to travel restrictions

in Wuhan. However, the case importation was declined by approximately 80% till the mid of February on the international scale due to travel restriction in Wuhan. Further, the modelling study reveals that additional travel restrictions in the mainland of China have only limited effect unless integrated with the public health interferences. Qiu et al. (2020) have described the risk correlated with the tourism activity from residents understanding in the three Chinese cities during the pandemic. A triple-bounded dichotomous choice contingent valuation model (DCCVM) was utilized to model the residents willingness to pay (WTP) in order to minimize the risk linked with tourism. Further, the findings of the study present valuable suggestions for the implementation of stimulus and restoration strategies in tourism during and after the COVID-19 outbreak. To analyse the effect of travel restrictions on the aviation industry globally, a forecasting model has been proposed by lacus et al. (2020). Based on the data extracted from the online booking system and online flight tracking system, the proposed model displays the analysis of changes in the activity of aviation all over the world during the pandemic of COVID-19. To overcome the challenges occurred in aviation due to travel restriction, various strategies depending on past pandemic and recognized flight volumes have been provided. From the findings, it was observed that world GDP declined by 0.02%–0.12% and in worst case loss may be approximately 1.41%–1.67% by the end of 2020 because of the effect of COVID-19 on aviation sector. The COVID-19 effect also results in loss of 4.2–5 million jobs by the end of 2020. Further, this analysis may aid the policy makers in implementing appropriate policy measures to overcome the problems raised in the aviation sector due to pandemic.

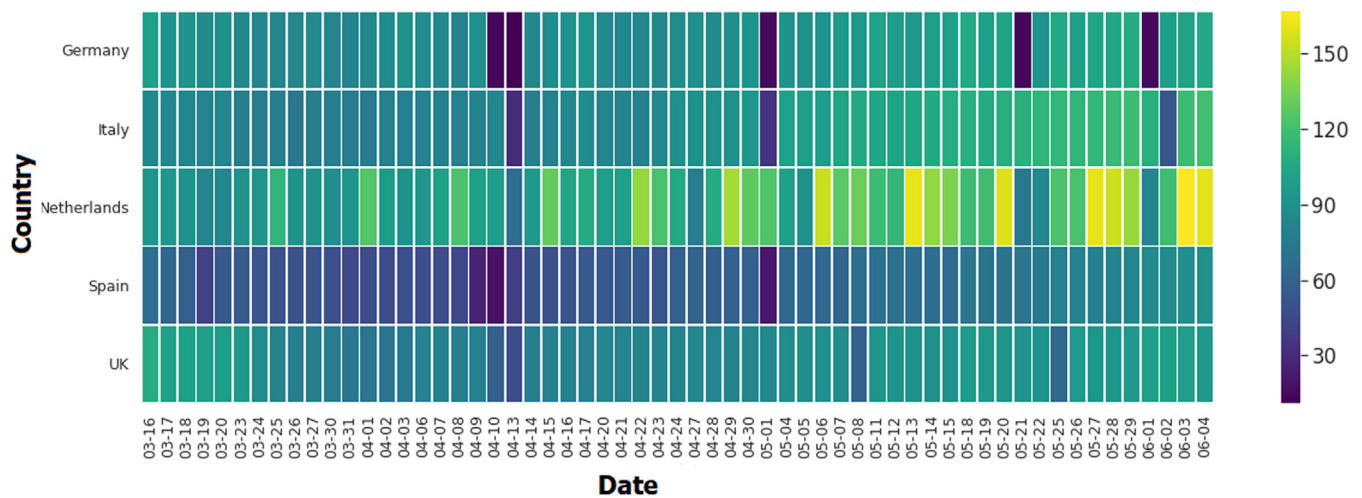
## 5.1 | Impact of COVID-19 on public transport

Public transport such as railway, metro, airlines, taxis and buses are acts as a carriers and distributor of disease and will harshly pretended by unremitting rules of social-distancing. Due to the limited operation of the public transport system in the lockdown period, severe losses have been incurred in all the modes of public transport (<https://moneycontrol.com>). Following are the few instances that explain the impact on public transport:

- Indian railway will lose Rs. 6000 crore–Rs. 12,500 crore from passenger trains and Rs. 6000 crore for freight services. Similarly, the Indian aviation industry is expected to lose around 3–3.6 Billion USD during these COVID-19 breakouts owing to grounding of all international and domestic flights.
- From 16 March 2020 to 8 May 2020, there has been a noteworthy fall in public transportation activity in both the USA and Canada with respect to the data from 1 February 2020 to 15 March 2020. Figure 5 shows the heat map of commercial transportation volumes based on a percentage drop from a normal weekday or weekend, with respect to the above baseline data. Averagely, 79% of public transport activities has been operating in Canada is operating at 79% of normal commercial transportation activity, whereas 70% of commercial transport in Maritimes (the lowest percentage compared to normal; Geotab Data & Analytics Team, 2020). In USA, the influence is more substantial, effective at an average of 83% of normal commercial transportation activity and the U.S. Federal Region, which includes the State of New York and New Jersey, most impacted at 66% of normal activity.
- The impact on transport sector in Europe of COVID-19 has also observed a similar statistic as shown in Figure 6. Spain has seen the highest drop-in transportation activity obeying the guidelines of social-distancing from 16 March 2020. In UK the fleet activity has started to drop much later (Geotab Data & Analytics Team, 2020). Netherlands has the least impact during the Covid-19 pandemic and the fleet activity has



**FIGURE 5** Heat map of region-by-region breakdown of commercial transportation volumes from 1 February to 15 March 2020 (curtsy Geotab Data & Analytics Team, 2020)



**FIGURE 6** Analysis of commercial vehicle activity volume by country in Europe (curtsy Geotab Data & Analytics Team, 2020)

started to increase since April 29. In 2019, the tourism and transport industry in Lazio of Italy has generated a revenue of 30.2 billion euros. In the best-case scenario, this figure is predicted to decrease to 25 billion euros in 2020, while it will be dropped to 19 billion euros in the worst-case scenario (Statista Research Department, 2020).

The following are the few additional matters that integrate with the present COVID-19 concerns of transport industry.

- The extreme rate of everyday washing of automobile and amenities have enhanced fixed costs and enforced an added economic pressure on all modes of public transport corporations at a time when there is zero income from the transport of passengers.
- Transport industry should make sure that transportation system's continuity during the virus spread considering all lockdown measures, arresting a balance between reduced operations and providing sufficient measurements for frontline workforces to be able to drill public distancing.
- Long-term investment programmes may possibly re-planned and re-prioritized, in light reduced profits.
- Government must plan for the obtainability of main personal to ensure with staff with critical skill and training available throughout the pandemic to keep networks safety.

## 5.2 | Impact on tourism

A decline of 13.5% is observed in the arrivals of tourist in Indonesia. Similarly, countries like China, Vietnam, and Thailand also experienced a dramatic decrease in the tourist arrivals (Molly Moore, 2020). The outbreak of respiratory lung infection known as COVID-19 with its origin in Wuhan city of China started spreading just before the event of Chinese New Year of 2020. Consequently, the plans over the festive period have been hampered because of the increase in the number of COVID-19 infected cases and travel restrictions. In addition, the restrictions in both the domestic and international travel have resulted in the consequent losses in the tourism sector. As the number of COVID-19 cases is increasing in other regions of the world, the citizens of the Asia Pacific region declared to ban the flights from China.

China is well-known for its economic dominance within the regions of Asia Pacific. The level of prosperity among the citizens of China has been increased because of its thriving economy. This increase in the income level of citizens has allowed the Chinese people to travel to other regions of the world frequently, particularly to the Asia Pacific region. As the domestic tourism has been increased due to the frequent travel of Chinese citizens, many countries across the Asia Pacific region started relying on the Chinese tourist to strengthen their tourism sector. Interestingly, Chinese tourism has contributed to the growth of GDP in Asia Pacific region in the year 2018. Therefore, the economies of Hong Kong, Singapore and Thailand have suffered severely during COVID-19 due to the travel restrictions on the Chinese tourism. In fact, a loss of 211 billion U.S. dollars was predicted in the economy of Asia Pacific region due to the outbreak of the pandemic. Even though the outbreak of previous infections has disrupted the tourism sector in the regions of Asia Pacific, the disruption occurred in the tourism sector due to COVID-19 is more when compared to previous infection. This is mainly due to the fact that the tourism sector in Asia Pacific region in previous years was not dependant on the Chinese tourism as they have been in recent years.

## 6 | IMPACT OF COVID-19 ON AGRICULTURAL SECTOR

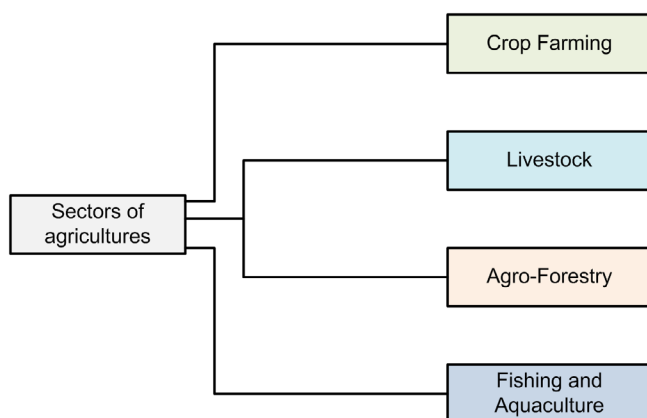
Over the past epidemics that the world has faced, it has been proved that pandemic and quarantine has not only affected activities of humans and economic growth but also affected agricultural activities. The impact of the COVID-19 is devastating on the economy. When there is a spread of contagious disease, there is a rise in malnutrition and starvation. The condition degenerates as the infection grows, making group limitations progressively severe, cause labour deficiencies for the harvest or complexities for farmers in transporting goods to the market. Agriculture is one of the major significant fields in human growth. In order to survive their lives, nearly 60% of humans impart on agriculture and hence it remains central to the entire world economy (Zavatta, 2014). Agricultural sector affected due to a severe pandemic and varied across various divisions that form the farming value chain. The agriculture fields include firms mostly occupied in increasing crops, raising animals, and harvesting fish as well as other animals. The area of agriculture is comprised of many sectors such as horticulture, plant genetics, seed technology, pests and pathogens, engineering, veterinary, poultry, dairy, food processing, farm mechanization, irrigation, storage and refrigeration, energy and biofuels, soil and water conservation, soil science, animal feed, fertilizers and chemicals, water resources and ground water hydraulics, climate, city planning, green buildings, structural design for storage and animals, GIS and remote sensing, agricultural marketing, agricultural entrepreneurship, agricultural education and research and many more. All these sectors have a major impact due to pandemic. Similarly, some of the subsectors of agriculture that include crop farming, livestock, agroforestry, and fishing and aquaculture also had serious impact due to COVID-19. These subsectors are mentioned in Figure 7.

The issues in agriculture are majorly related to the non-availability of labour and incapability to access markets for manufacturing due to problems in the functioning of markets and transportation. Non-availability of labour has damaged functions in several parts. A few parts of agriculture that have the comfort of organizing tools for yielding include wheat, as well as paddy, are comparatively more protected as they frequently need not be rely on manual labour. The rising utilization of automatic producers for paddy has assisted in the current situations, even if their inter-state progress has been strictly shortened. Yet, marketable crops are severely hit as they likely to be more reliant on immigrant labour. Thus, the scarcity of immigrant labour has resulted in a quick rise in everyday wages for yielding crops. In most of the areas, the increase is as high as 50%, making it worthless for manufacturers as costs have distorted because of deficiency of market access either by preventing transportation or closing of borders. The farming economy faced a serious burden when lockdown stopped transportation, thus by rusting the yield. The production of the farmers could not arrive to mandis, so disturbing the supply chain. Similarly, non-availability of immigrant labours interrupted the harvest as well as post-harvest functioning's. The epidemic has provided growth to various confronts in procurement functions as well. Landless farm labours, marginal farmers and so on has experienced many challenges. So government is working hard to give alternative returns until the financial system falls rear into its place.

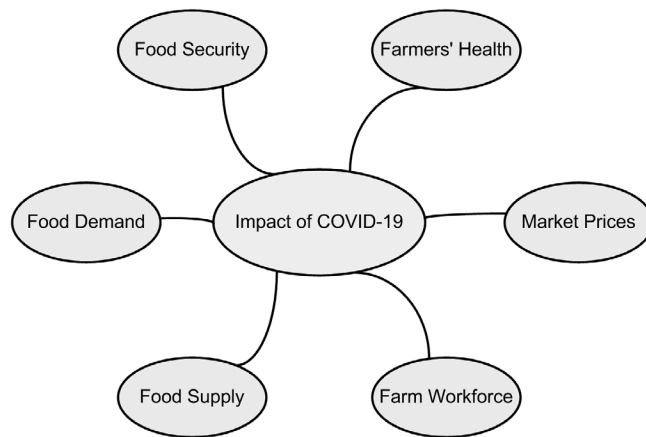
### 6.1 | Affected agricultural sectors due to COVID-19

The fast-developing conditions with COVID-19 are increasing questions throughout the globe. As distresses persist to rise about the infection, it is not only inflicting disaster on the stock market but also causing a major decline in the economy. The agricultural and food organization (FAO, 2020) described that impact of COVID-19 on agriculture includes various aspects like food supply, food demand, food security, markets and farm prices, farmers' health, the farm workforce, worker safety and personal protective equipment (PPE) and other disruptions. These effects are depicted in the following Figure 8.

The following are the few literatures that show the impact of COVID-19 on food supply and production. Siche (2020) has described the study and analysis of the effect of COVID-19 on the food supply and agriculture sector. Further, the data collected from the scientific and technical



**FIGURE 7** Subsectors of agriculture sector affected by COVID-19

**FIGURE 8** Impact of COVID-19 on agriculture

records, the Food Agriculture Organization (FAO) and the World Health organization have been used for the analysis of the impact of COVID-19 infection on the agriculture sector. From the analysis, it is noticed that COVID-19 infection has greatly distressed the food demand and accordingly food security because of the transport restrictions and decreased purchasing capacity. The assessment of challenges faced by the food supply chain in Canada during the crisis of COVID-19 pandemic and the policies and industrial strategies taken by the Canada government to enhance the resilience of food supply chain has been depicted by Hobbs (2020). The impact of disruptions in the demand of food supply chain such as panic purchasing attitude of the consumer related to essential items and changes in consumption styles due to the closure of food retailing sector has been analysed. Moreover, the assessment of disruptions in the supply-side of the food service sector such as shortage of labour and mobility restriction due to the closure of Canada-U.S. border has also been discussed. Finally, the long-lasting effects due to COVID-19 on the nature of the food supply chains in Canada have been examined. The disruption occurred in the agricultural production in China due to COVID-19 pandemic and the measures taken by the government to reduce the negative effects in agricultural production has been considered by Pu and Zhong (2020). The study reveals that lockdown policy to control the spread of infection leads to disruption in the agricultural production such as obstruction in the outflow transmit of agricultural products and hamper in the essential production input, production cycles and production capacity. Moreover, it also projects the policies taken by the China government to enhance the food supply chain and effective strategies for efficient delivering of agricultural products. Further, this study also provides suggestions to other countries particularly in developing countries to cope up with the challenges encountered in the agricultural production due to pandemic.

## 6.2 | Impact on food supply

The majority of nations adopted preventive actions like home quarantine, travel restrictions as well as stoppage of business to decrease the infection rate. Such type of travel ban had affected the food supply with a key impact on food delivery (Poudel et al., 2020). As mentioned in Figure 7, various subsectors of agriculture have faced hard-hit globally due to COVID-19. The scarcity of labour as well as limited animal feed has caused a high impact on livestock agriculture in china (Zhang, 2020). Delivery of poultry's breeding supply has been affected due to the stoppage of travelling. Fishing activities were condensed in various parts of Asia, Africa as well as Europe because of hygienic procedures, the partial inputs supply and lack of labour (FAO, 2020a). There is a complexity in the production of aquaculture due to the shortage of seed and feed. The delivery of dairy products have stroked hardest by the pandemic. The deficiency of agricultural inputs like seed, pesticide, and fertilizers are faced by the farmers due to overall trade disturbance. The epidemic has distressed the planting of several crops include sunflower, barley, maize, spring wheat, and so on. To defeat these whole situations, most of the organizations like government as well as non-governments are playing a vital role to handle continuous supply chain.

The following review shows how the seafood sector has been influenced by the spread of the COVID-19. The assessment of COVID-19 impact on the seafood sector in United States has been presented by White et al. (2020). The most frequent impacts of COVID-19 on seafood sector such as widespread closure of restaurants, reduced fishing season and revenue loss have been described in the study. From the assessment of data collected from the Google search trends and seafood market foot traffic, it has been depicted that the consumer need for seafood from restaurants has dropped by 30%, even though other ways of delivering seafood such as takeout has been enhanced. Furthermore, the study also reveals that the fresh seafood market has affected more when compared with frozen products by considering data from the minimal accessible landing data along with national level import and export data. Moreover, the findings observed from this study may assist the policy makers to focus support on areas of seafood sector mostly distressed due to COVID-19.

### 6.3 | Impact on food demand

Customer's interest and capability to acquire goods as well as services in a providing period is referred to as demand. Food demand has influenced due to a decline in profits and purchasing capability. However, the rate of the supplies relays on the nation and their strategy to manage the pandemic. Siche (2020) has stated that the essential requirements are anticipated to persist constant, even as point in cost probably will arise for high valued goods. In the current situations, the usage levels of consuming animal proteins as food reduced drastically due to the suspicion of animals as a cause of disease.

### 6.4 | Impact on food security

The existing and accessing of an adequate quantity of healthy food in a constant manner can be considered as food security. The problem of food security has risen due to the prohibit of international trade. The rise of food security due to COVID-19 mainly affects the deprived and the majority susceptible parts of the population. According to a study (FAO et.al, 2019), 820 million citizens are fronting severe hunger at present and 113 million citizens are facing acute uncertainty. More than 10 million children rely on the meals provided by their schools to complete their nutritional necessities. But because of banning schools and school meal programs, children are not receiving their meals that may decrease the capability to cope up with this pandemic (FAO, 2020b).

### 6.5 | Impact on markets and farm prices

As we notice raising levels of suggestions for social distancing, concerns, condensed travel, evading crowds, closures, and additional defensive practices to slow down the COVID-19 spread, consumers will be building hard alternatives about food, eating outside, and overall expenditure. Dairy is highly featured in outside-food, and there may be a few disturbances in foodservice deals. This scenario has an impact on markets and their prices. There has been a stoppage at ports in many countries as ships remain to be divesting with U.S. dairy as well as other farm products. Considerations about the effect of the pandemic on the widen economy are probable to include an even superior impact on the prices of dairy products.

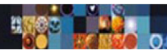
### 6.6 | Impact on farmers' health

All over the Midwest, as contrasted to the general employer population, farmers are comparatively older population. According to an age census in 2017, the normal age of farmers to be roughly 58, a complete 10 years older than employers in most of the other fields. Compared to other sector workers, 26% of farm workers are at the age of 65 years and above. A complete 11.7% of our major farm workers are at the age of 74 years and some are even more than that. Information from many other countries that have completed wider testing has suggested that, the impact of COVID-19 has a higher level of seriousness for those farmers who are in their 60 years and above. The defensive and protective suggestions from the state as well as central public health specialists are critical for our agricultural population.

### 6.7 | Preventive measures to deal with pandemic

To cope up with the challenges faced by the agricultural field due to the pandemic, some measures are needed to take to make the agricultural sector working normally. Some major measures have been taken by the Indian government to help the farmers in the agricultural fields. The home ministry has positioned some guidelines for ensuring less injure to the field of agriculture. Supply chain especially for milk, tea, plantations, and so on supposed to be restart as common while taking social distancing. Allowance of normal operations of agriculture is done by the centre in rural areas. Marine, Medical systems, pharmaceuticals, fishery procedures, and infrastructural units are supposed to be functional. Import and export are on the border of falling back to the normal stage as remaining in the mind to prevent the spread of infection. The government of India has suggested alleviation measures to guarantee a sustainable food organization in the pandemic. After announcing worldwide lockdown, the Indian finance minister confirmed 1.7 trillion packages immediately to secure the susceptible sections including farmers from any unfavourable impacts of the COVID-19. The government has declared an advance release of INR 2000 to bank accounts under the scheme of PM-KISAN as income support to all the farmers. Workers' wage rate has been increased by the government under the largest wage assurance scheme NREGS. To help the vulnerable population, the government has announced the Pradhan Mantri Garib Kalyan Yojana scheme for the welfare of the poor people. Extra grain allocations to listed recipients were also declared for the coming 3 months. Support of Food and cash to individuals occupied in the





informal field, frequently immigrant labourers, has also been declared for which a separate PM-CARES (Prime Minister Citizen Assistance and Relief in Emergency Situations) fund has been established. The Indian Council of Agricultural Research (ICAR; Guidelines, 2020) has concerned nationwide strategies to be followed by the farmers during the period of a pandemic. Wheat harvesting is approaching in various states by uniting producers as well as their movements within and among the states that have been allowed. Mustard, lentil, maize, chilies, and sugar and harvesting are at peak stage for progressing as well as harvesting. This guideline is mentioned in the following Table 2.

The Reserve Bank of India (RBI) has also declared detailed measures that deal with the weight of debt servicing due to pandemic. Conditions of agriculture as well as crop loans have been approved a suspension of 3 months up to 31 May by banking organizations with a 3% allowance on the concerned price of crop loans up-to INR 300,000 for users with superior refund nature. Though the government has taken the proper guidelines of lockdown, taking proper measures for farming sectors, still some problems include execution leading to deficiency of workers as well as declining costs should be resolved. The functioning of the food supply should organize well. The population of the farming must be secured from COVID-19 to the extent possible by testing and working social distancing. Farmers should have continues entrance into the market. Dairy and poultry farmers required to receive more help, since their epidemic-linked supply as well as market access issues are vital.

## 7 | IMPACT OF COVID-19 ON EDUCATION SECTOR

The pandemic COVID-19 leads to social distancing policies in more than 200 countries throughout the world. Since the coronavirus is an infectious disease, it spreads majorly by physical (social) contact. This pandemic situation of COVID-19 affects many sectors such as agriculture, automobiles, finance, and so on. The No. of cases of COVID-19 started raising from March 2020. Due to this rapid increase in spread, it mainly affects the education sector, especially during March. More number of people are present in educational institutions, universities, private institutes, and so on. To avoid the conflict of the spread of corona, an initiative has been taken by the government as well as private educational institutions and universities to remain shut down. Almost, 75 million children and youth have been disrupted in their education globally and that effect is being increased due to COVID-19. Nearly education of 1.53 billion of all aged students in more than 184 countries has been affected. Many primary,

**TABLE 2** Guidelines provided by Indian government to deal with COVID-19

Type of farming	Guidelines to be followed
Threshing and harvesting of crops	<ul style="list-style-type: none"> <li>• Farmers, who generally work in the harvesting of crops, vegetables, fruits, fishes, and eggs, should follow social distancing as well as measures of personal hygiene</li> <li>• Minimum 4–5 feet distance should be maintained by manual field harvesters</li> <li>• Each individual is assigning spaced strips so that sufficient spacing among working labour will be guaranteed</li> <li>• Usage of masks and hand wash before and after field operations are strict ought to be followed</li> <li>• Prevent working more number of individuals on the same date</li> <li>• Instead of performing manual operations, choose automation process. Only major person should be allowed to escort the machine</li> <li>• All the equipment, gunny bags, wrapping materials as well as moving vehicles should be sanitized at entry as well as regular times</li> <li>• The collecting procedure should be handled one or two persons, not more than that to prevent crowding</li> </ul>
Post harvesting, storage and marketing of farm produce	<ul style="list-style-type: none"> <li>• Wearing of securing face masks at the time of threshing, grading, winnowing, cleaning and sorting at the farming helps against dust and aerosol particles to avoid complexities in respiratory problems</li> <li>• Should use dried funnies after drenching in neem solution and should not reuse early seasoned jute bags to avoid pest invasions</li> <li>• Accurate precautions need to be taken for storing productions at the farming like making them accessible to farmers or nearby warehouse if required for increased cost realization</li> <li>• Sufficient individual safety measures to be obtained for loading and moving of farm products while contributing to sales at markets</li> <li>• Seed producing farmers are allowed to move to seed companies and to pursue safety measures while getting payments</li> <li>• Direct marketing or suppliers of vegetables from farms need to follow the precautions</li> </ul>
Standing field crops	<ul style="list-style-type: none"> <li>• Farmers can holdup harvesting of wheat with no major loss due to having long term average temperatures in most of the growing areas of wheat; therefore, they got enough time to handle logistics for declaration and procurement of dates</li> <li>• Correct protections need to be acquiring while spraying suggested fungicide by farmers</li> <li>• Measures passed to spray an amount of 5% salt solution in order to avoid seed germination to the paddy crops during unseasonal rain</li> <li>• Washing equipment, handling inputs, mixing, and delivering of products need to take sufficient precautions</li> </ul>

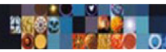


secondary schools, higher education boards as well as universities have taken several steps to avoid the transmission of COVID-19. Some of the measures taken by different universities in top COVID-19 affected countries are mentioned in Table 3.

A few literature reviews that show how the education system has been impacted due to the pandemic COVID-19 have been discussed here. An analysis of the consequences of COVID-19 pandemic effect on Indian education system has been presented by Jena (2020). In this study, the measures adopted by the government of India to ensure consistent education in the country have been emphasized. Further, the positive and negative impacts of the pandemic on education system have also been highlighted. Moreover, some productive suggestions are also projected for the smooth accomplishment of educational activities at the time of the pandemic situation. The consequences of COVID-19 pandemic on higher education institutions due to shut down of schools in Nigeria has been analysed by Jacob et al. (2020). Further, the decline of international education, interruption of academic calendars of higher education, revocation of international conferences, deficiency of work force in educational institutions, generation of gaps between teaching and learning process and reduction in the budget of higher education are considered as the areas of higher institutions affected due to the COVID-19 pandemic. In addition, this study also suggests some measures to government such as enhancement in the budget of higher education that may enable the higher education institutions to cope up with the damage induced by the closure of schools due to COVID-19 pandemic. An online survey from 1 May 2020 to 8 May 2020 was carried out by Kapasia et al. (2020) to determine the effect of lockdown on both undergraduate and postgraduate students of distinct colleges and universities of West Bengal in India. The survey was analysed using straightforward percentage distribution approach to determine the learning status of the study members. Further, the analysis reveals that 70% learners were actively participating in e-learning process. The survey also shows that majority of the active learners were using android mobiles for attending the online classes. Moreover, the study also discloses that the students particularly from remote area and weaker

**TABLE 3** Actions taken by various universities in top COVID-19 affected countries

S. No.	Country name	Measures taken by several universities	Announcement date	Reference
1	China	<ul style="list-style-type: none"> <li>Initiation of Spring Semester has been announced to be postponed in Beijing</li> </ul>	26 January 2020	(Berlinger et al., 2020)
		<ul style="list-style-type: none"> <li>Almost all the colleges as well as universities in China remain closed by Ministry of China's education</li> </ul>	28 January 2020	(Khaliq, 2020)
		<ul style="list-style-type: none"> <li>Also, benchmark examination tests like Graduate Record Examination (GRE), and so on were stopped</li> </ul>	28 January 2020	-
		<ul style="list-style-type: none"> <li>Many higher education institutes reported the postponement until the midst of February month</li> </ul>	2 February 2020	(McKenzie, 2020)
		<ul style="list-style-type: none"> <li>By taking student's educational life into consideration, online classes have been initiated by New York University</li> </ul>	17 February 2020	Shanghai, 2020
		<ul style="list-style-type: none"> <li>Zhejiang University have also started online classes</li> </ul>	24 February 2020	(University of Zhejiang, 2020)
		<ul style="list-style-type: none"> <li>Peking University and Tsinghua University have also started online classes</li> </ul>	1 March 2020	(Leung & Sharma, 2020)
2	Germany	<ul style="list-style-type: none"> <li>University of Passau remains closed due to COVID-19 pandemic</li> </ul>	12 March 2020	(Passau University, 2020)
		<ul style="list-style-type: none"> <li>Instruction have been given to faculty to work from home</li> </ul>	12 March 2020	
		<ul style="list-style-type: none"> <li>Announcement regarding cancellation of exams has been declared</li> </ul>	18 March 2020	
		<ul style="list-style-type: none"> <li>Heidelberg University (2020) remains closed for the remaining semesters</li> </ul>	22 March 2020	(University of Heidelberg, 2020)
		<ul style="list-style-type: none"> <li>University of Passau buildings were closed</li> </ul>	From 24 March to 19 April	(Passau University, 2020)
3	Italy	<ul style="list-style-type: none"> <li>Ministry of University of Italian declared that online class will be conducted via Skype</li> </ul>	2 March 2020	(Giorgio, 2020)
		<ul style="list-style-type: none"> <li>The Basilicata University conducted classes in their buildings by performing thermal screening to each and every member</li> </ul>	2 March 2020	(Basilicata, 2020)
		<ul style="list-style-type: none"> <li>Internships related to medical field were stopped</li> </ul>	2 March 2020	(Bari, 2020)
		<ul style="list-style-type: none"> <li>Italian Government closed Universities as well as Schools</li> </ul>	4 March 2020	-
		<ul style="list-style-type: none"> <li>The Catania University started e-learning procedure</li> </ul>	19 March 2020	-
4	USA	<ul style="list-style-type: none"> <li>University of Harvard made an announcement that everything will be run through online mode</li> </ul>	10 March 2020	(Harvard Gazette, 2020)
		<ul style="list-style-type: none"> <li>Southern Oregon University also made an announcement that everything will be run through online mode</li> </ul>	19 March 2020	Southern Oregon University (2020)



economic sections are encountering vast challenges while involving in e-learning process. Finally, the study suggests some measures to the government, authorities of the institution and policy makers such as uniform academic plan, proper Education Continuity Plan (ECP), adequate funding and development training for employability to establish strong education system in the state. A study that shows how the educational system has been changed throughout the world due to COVID-19 pandemic was presented by Toquero (2020). In this study, some measures to the higher education system such as revision of the academic curriculum towards online learning, implementation of health practices by developing health management protocols and environmental strategies that can enhance the health management system in the university have been suggested to upgrade the present mode of education to the emerging technologies. Further, this study serves as research evidence to cope up with the challenges that arise due to the pandemic in the educational system.

Due to the hectic situation of COVID-19, the education sector is badly affected. Many subsectors such as service providers, supplementary providers, educational product providers, and so on have been affected. Many charters, primary, secondary as well as virtual schools have been closed. Several educational organizations faced problems to give salaries to their employees. Many learning centres remain closed. Several services of vocational, tutorial as well as assessment were stopped. Various examinations of government have been postponed. Production, supply, and demand for different educational products were stopped and due to this reason, several employees were affected financially. Many decisions were made by several universities like Hyderabad University remains closed and stopped all the activities on 20 March 2020 and many more. The sectors of education that were affected by COVID-19 have been depicted in Figure 9. This effect on education has particularly hit hard in India. Many youths as well as children remain locked at their homes due to the new initiate policies of the Indian government. Not only the youth and children but also the people all over India stayed home after incorporating a new rule of lockdown.

The Government of India has observed the rapid increase of COVID-19 cases throughout their country. On 22 March, honourable Prime Minister of India, Sri Narendra Modi announced Janata Curfew. Later from 25 March to 14 April, 21 days of lockdown has been announced which is called a lockdown 1.0. Later from 15 April to 3 May, the extension of lockdown for 19 days has been declared and called it as lockdown 2.0. Later, an extension of 14 days of lockdown 3.0 has been declared from 4 May to 17 May 2020. From 18 May up to 31 May and from 1 June to 30 June, the lockdown has 4.0 and 5.0 has been implemented. After lockdown 5.0, the unlocking of cities has started slowly. Although, several sectors have allowed for normal working style with a proper COVID-19 guideline, the education institute have remained closed. However, the teaching processes are going on through online platform. Due to these lockdown and unlock period, several disruption has occurred in the educational system of India. Schools as well as universities of the public as well as the private sector of the Indian educational system remain closed. Many categories of universities such as Central, Government Deemed as well as Government Aided Universities, Private deemed to be university, Institute of National Importance, State Private University, and State Public University have been affected. The sectors of education which are badly affected due to the COVID-19 pandemic have been depicted in Figure 10.

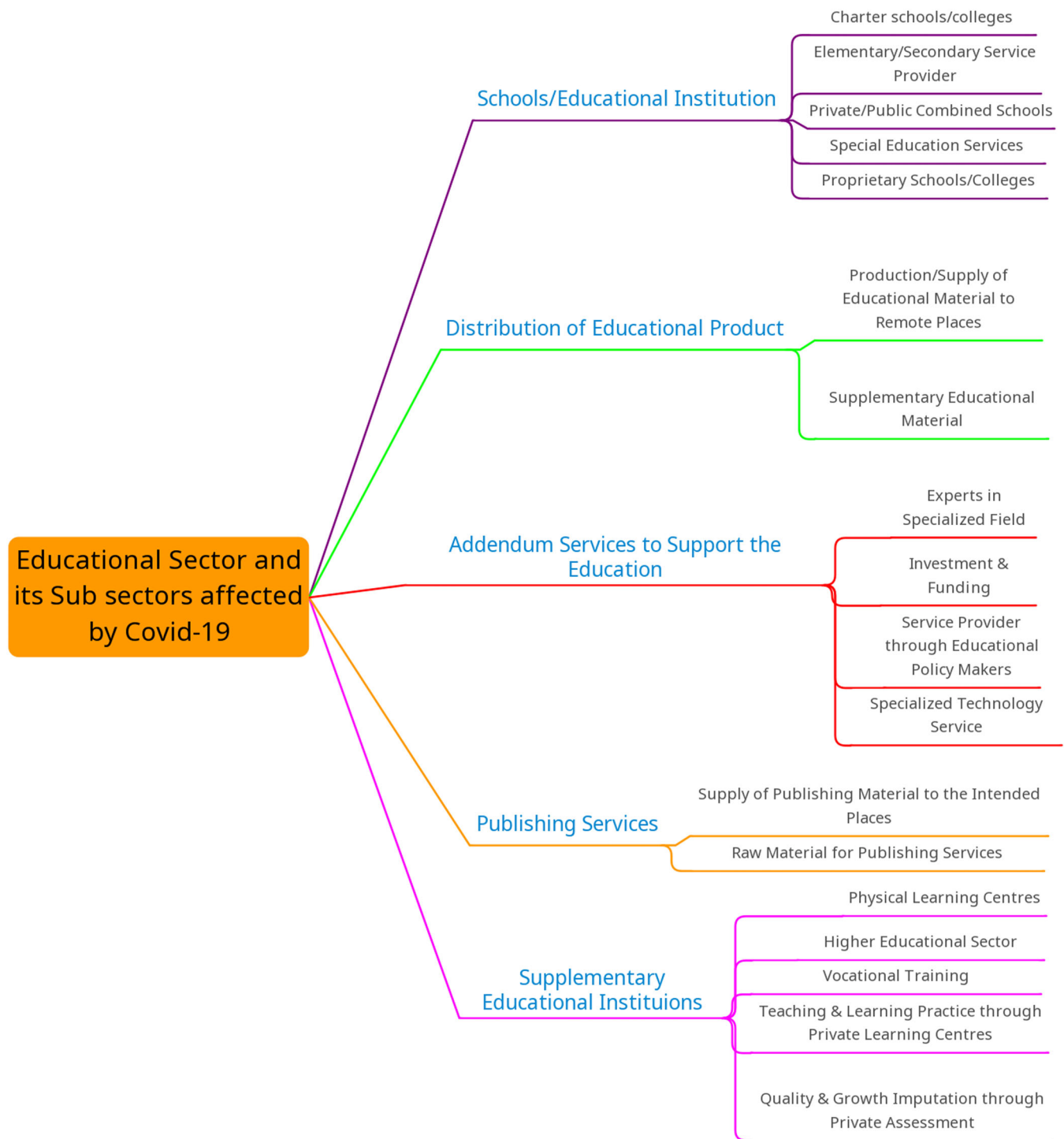
Some of the effects of COVID-19 on several universities in India have been described in the following manner.

- On 24 February, the University of MRIIRS (Manav Rachna International Institute of Research and Studies), Faridabad continued public gathering (Students; Faridabad, 2020).
- Some schools throughout India remain closed while some of the schools have not declared their announcement throughout India (Economist, 2020).
- On 16 March 2020, postponement of all exams has been declared by the Maharashtra Government (Outbreak, 2020).
- On 17 March, Schools in the capital of India, New Delhi declared holidays (PTI, 2020). All academic activities have been closed by Pondicherry University (COVID-19 scare: Pondicherry, 2020).
- On 20 March 2020, the University of Hyderabad remains closed and stopped all the activities. Instructions have been given to students in hostels to evacuate the hostel by going their homes (Faridabad, 2020) and many more.

Many schools as well as colleges declared to promote students to the next higher levels without conducting any examinations due to the COVID-19 crisis. Like, the Government of Andhra Pradesh, Telangana, Odisha, Gujarat, Uttar Pradesh, Maharashtra, Pondicherry has declared that up to classes of ninth grade, all the students will be promoted to the next levels without examinations. But, for matriculation students, the exam will be conducted and dates of examination yet to be announced. Also, many measures announcements were made by AICTE (All India Council for Technical Education), New Delhi, and UGC (Under Graduate Commission), New Delhi, and those were mentioned in Tables 4 and 5.

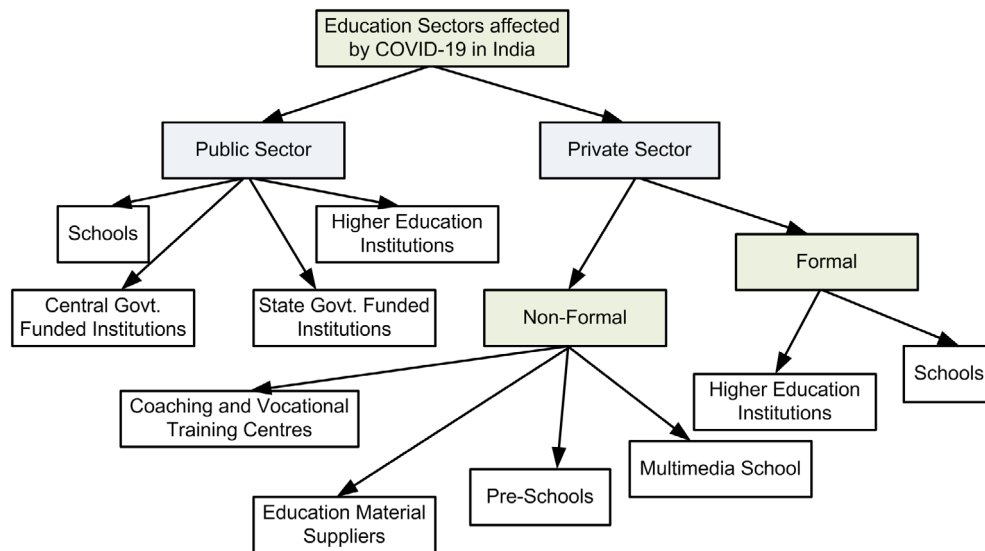
## 8 | IMPACT OF COVID-19 ON PUBLISHING INDUSTRY

The sudden surge of COVID-19 pandemic has distressed many industries and affected the lives of people across the world. While the COVID-19 has a negative impact on the global economy, there exist some industries that are faring better than other industries during the pandemic period. In the case of the publishing industry, the COVID-19 crisis has created a mixed impact on the economy. Due to the sudden surge of COVID-19 pandemic, many governments across the world have declared lockdown to inhibit the spread of the pandemic. As millions of people pursued



**FIGURE 9** Sectors of education affected by COVID-19 pandemic throughout the world

education from home, the demand for academic publishers having rich source of online publications has increased in comparison with the publishers having limited source of resources. The number of visits for online material has increased from 1.34 billion in January 2020 to 1.51 billion in March 2020 (<https://www.statista.com/statistics/1112583/covid-19-impact-books-e-commerce-site-traffic-global/>). As people are staying at home during the crisis period, they are finding the ways of enhancing their skill set or ways of entertainment by purchasing books through online or by visiting online resources. In the United States, the sales of children non-fiction books have raised by 66% in the third week of March (<https://www.weforum.org/agenda/2020/04/coronavirus-escapism-book-sales-surge-covid-19/>). Hence, the rise in the online retailers and eBooks show that there is a raise in the sales of book during the pandemic period. As the COVID-19 has resulted in the economic deceleration



**FIGURE 10** List of subsectors of education affected by pandemic COVID-19 in India

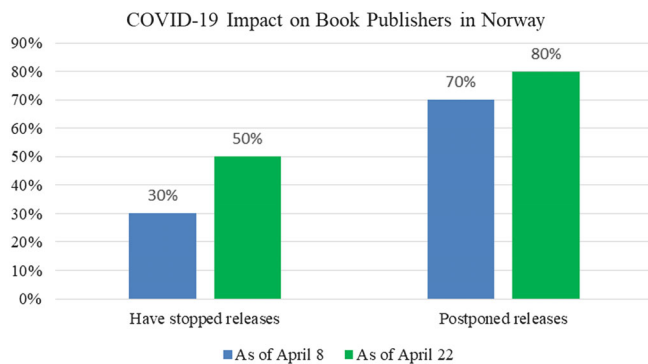
**TABLE 4** Measures taken by UGC during lockdown in months of March, April, May, 2020

Measures taken by UGC for pandemic COVID-19	
Date of announcement	Notification released
5 March 2020	Advisory for universities and colleges to avoid gathering at campus, taking measures such as hand and respiratory hygiene due to COVID-19
19 March 2020	Precautions to be taken in the light of novel COVID-19
21 March 2020	Permissions as well as preventive measures to teaching and non-teaching staff to work from home
25 March 2020	ICT initiatives of on-line learning
27 March 2020	Safety and care of hostel residents
28 March 2020	Appeal for contribution to combat COVID-19
5 April 2020	Mental health and wellbeing of students during and after COVID-19 outbreak
10 April 2020	Downloading Aarogya setup app for effectively identifying the COVID-19 cases
17 April 2020	Issues related to examinations as well as academic calendar (possible delay of examinations)
25 April 2020	Press release on examinations and academic calendar (shifting of examination from march to first week of May, 2020)
29 April 2020	UGC Guidelines on Examinations and Academic Calendar in view of COVID-19 pandemic
10 May 2020	Redressal of grievances relevant to COVID-19 pandemic
26 May 2020	Monitoring grievances relevant to examinations and academic calendar in view of COVID-19 pandemic
12 June 2020	Issuing letter regarding facilitation of study on impact of COVID-10 and 1918 pandemic (H1N1) by universities/colleges
24 June 2020	Press release on extension of UGC sponsored fellowships which are expired/expiring during the Corona pandemic period
6 July 2020	Press release on revised guidelines on Examinations and Academic Calendar for the Universities in view of COVID-19 pandemic
11 Nov 2020	Issued the guidelines on reopening of universities and colleges post lockdown due to COVID-19 pandemic

across the world, the global market of the Book publishing sector has decreased from 92.8 billion dollars in 2019 to 85.9 billion dollars in 2020 (<https://www.thebusinessresearchcompany.com/report/book-publishers-global-market-report-2020-30-covid-19-impact-and-recover>). Therefore, independent publishing sectors may suffer severely during the crisis period. The Figure 11 shows the impact of COVID-19 on the Book publishers in Norway (<https://www.statista.com/statistics/1109852/impact-of-the-covid-19-outbreak-on-book-publishers-in-norway/>).

**TABLE 5** Measures taken by AICTE during lockdown in months of March, April, May, 2020

Measures taken by AICTE for pandemic COVID-19	
Date of announcement	Notification released
13 March 2020	Circular regarding Advisory for Institutions and Colleges—COVID-19
29 March 2020	AICTE Approved Institutions as Temporary Isolation Centres to Combat COVID-19
29 March 2020	Preventive measures to accomplish social distancing—teaching and non-teaching staff to work from home
1 April 2020	Information required by AICTE Approved Institutes Running Hostels for Students Studying in the current situation
3 April 2020	MHRD AICTE COVID-19 Student Helpline Portal
8 April 2020	Coursera for Campus: Coursera's Coronavirus Response Initiative
15 April 2020	Instructions to Institutes/Colleges during lockdown 2.0 for withdrawing termination faculty, and so on
15 April 2020	Notification to PGDM Institutes on not to insist fee payments due to COVID-19
1 May 2020	Guidelines to standalone PGDM/PGCM institutes for commencements of classes to students of AY 20–21 from 1 July 2020 onwards, and so on
7 May 2020	Multi-institutional, multi-lingual science communication initiative—CovidGyan
18 May 2020	Circular to payment of fee during lockdown period (another request on not to insist payment of fees till situation of pandemic become normal)
23 Sept 2020	Circular to AICTE institutions to work with SPICMACAY to help student' alleviate mental stress due to the COVID-19 fostering Indian culture among youths

**FIGURE 11** Impact of COVID-19 on book publishers

## 8.1 | Impact on different sectors of the publishing industry

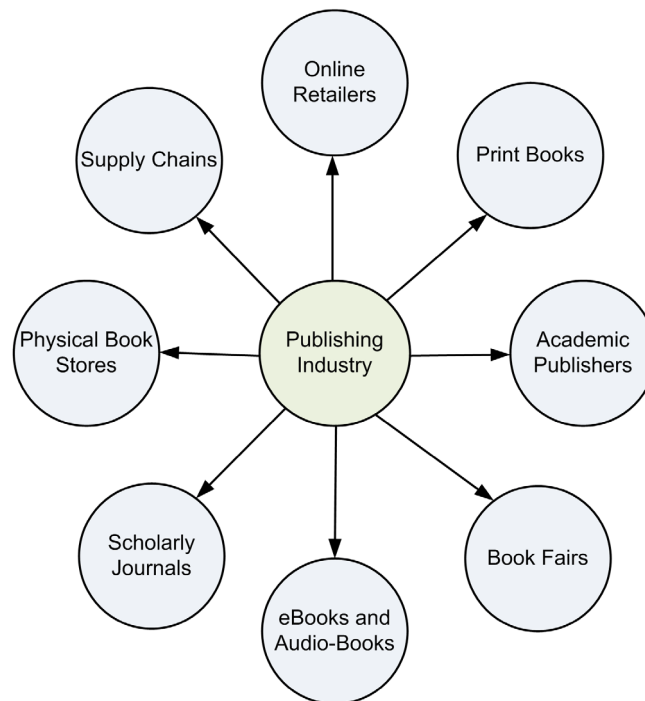
This section describes about the impact of COVID-19 on different sectors of the publishing industry. Figure 12 represents the different sectors of the publishing industry.

## 8.2 | Print books

Even though there is a growth in the sales of eBooks, there is a decline of 10% in the print sales due to the closure of libraries, physical book shops and educational institutions which in turn affects the authors, publishers and Book stores that depends on the print book sales.

## 8.3 | Online retailers

The online retailers like the Bookshop.org have shown 400% increase in sales, while Amazon has shown 50% increase in sales of all print books from major publishers (<https://www.weforum.org/agenda/2020/04/coronavirus-escapism-book-sales-surge-covid-19/>). Therefore, the online retailers are progressing much better than other sectors of publishing industry during the crisis.

**FIGURE 12** Different sectors of publishing industry

#### 8.4 | eBooks and Audiobooks

From the last few months, significant increase has been noticed in the choice of eBooks and Audiobooks in order to maintain the hygiene issues during the pandemic. The eBook distributors and publishers have seen rise of at least double digit in the sale of books since the lockdown. When it comes to Audiobooks, the distributors have noticed a slight drop in the beginning of the lockdown. Later, listening times have been increased when listeners made the new routines and adjustments.

#### 8.5 | Academic publishers

As online learning has become the new form of teaching-learning process, the academic publishers particularly those are having rich source of online resources are flourishing well during this pandemic period.

#### 8.6 | Physical bookstores

The small and independent business that depends on in-person sales has suffered a lot during the crisis times. Therefore, the retailers that depend on in-person sales have to shift towards online sales in order to survive at the time of crisis. For instance, iconic Powell's book store in Portland has removed 85% of its staff during the pandemic. When the store moved to online sales has again rehired 100 employees (<https://www.weforum.org/agenda/2020/04/coronavirus-escapism-book-sales-surge-covid-19/>).

#### 8.7 | Book fairs

Book fairs have been greatly affected by the COVID-19 pandemic. All the international book fairs have been cancelled due to the pandemic.

#### 8.8 | Scholarly journals

The advancement in Internet technology has brought rapid changes in the communication of scholarly journals. At the time of pandemics, the rapid dissemination of related scientific technology plays a vital role to handle the crisis. The factors affecting the dissemination of relevant

scientific knowledge through scholarly journals are the duration of the publication process. From the author's perspective, the duration of the publication process can be reduced by the use of preprint servers. When considering from the publisher's view, the rapid dissemination of scholarly articles can be enhanced by modifying the editorial policies and procedures. Therefore, the modifications in the policies and procedures of editorial attract the reviewers which results in the fast dissemination of scientific knowledge at the time of crisis.

## 8.9 | Supply chain

When it comes to the production sector, the supply chain shortage has created a negative impact on the publishing sector which results in the decrease of demand for the publishers and retailers.

## 8.10 | Trends introduced in publishing industry during pandemic

Due to pandemic some significant changes have been introduced in the publishing industry to meet the needs of the readers. As large number of uncontrolled piracy eBooks and publishers are available, digital platforms provided special discounts and free subscriptions to attract the readers. Another significant trend in the publishing industry is the release of eBook first followed by the release of print editions. To meet the needs of the reader, digital platforms have released some books prior to the proposed release date by observing the readers behaviour. The production of short reads and books related to cooking, Children activity and Home learning has been increased based on the consumption of books during pandemic.

## 9 | CRITICAL ANALYSIS

A systematic analysis of the various articles published on the impact of COVID-19 on different sectors has been carried out. This section represents an analysis of the impact of supply chain shortage in different countries of the automobile industry and a comparative analysis of domestic sale of passenger vehicles in India before COVID and after reporting COVID, usage of different sources of energy during the period January 2020 to June 2020 to overcome the imbalances occurred in the power load, impact of supply delay in various sector of global electronics industry, % change in the international tourist arrivals in 2019 and Q1 2020, impact on global revenue of travels and tourism sector in 2019 and Q1 of 2020, % drop in the market arrivals of major food items, procurement and sale of milk during the lockdown period in India, no of affected learners throughout the world and country wide closure of educational institutions to show the impact of COVID-19 on automobile, power and energy, electronics, travel and tourism, agriculture and education system. In addition to the above-mentioned sectors, an analysis of other sectors affected due to COVID-19 in India has also been presented. Further an analysis of GDP growth rate in India and unemployment rate has been performed to show the impact of COVID-19 on the economy of India. This analysis may help the policy makers in taking necessary actions to overcome the challenges encountered in various sectors.

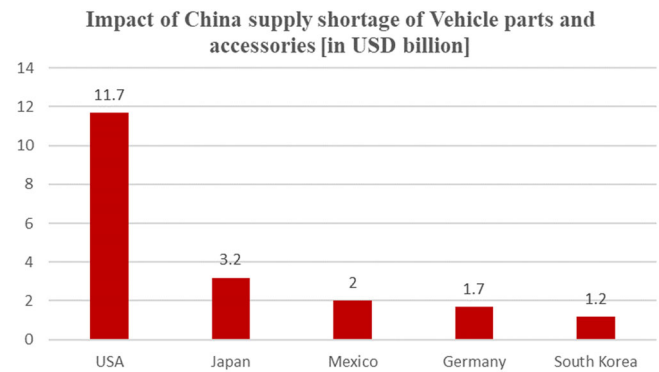
### 9.1 | Analysis on automobile industry

Automobile industry is one of the crucial industries responsible for the economic growth and prosperity of the country. For instance, in Europe the turnover of the automobile industry surpasses 7% of its GDP, in United States the turnover is 3%–3.5% of the total GDP and in China the turnover is 10%. The surge of COVID-19 pandemic has kept the automobile industry under great pressure because of the demand and supply factors. The automobile industry is facing a demand shock with unpredictable recovery timeline due to lockdown policies. The global auto production is mainly dependent on the exports of the automobile parts and accessories from China. Figure 11 depicts the impact of supply shortage in China affecting the assembly of original equipment manufacturers (OEMs) in North America, Europe and Asia. From the Figure 13, it can be observed that USA is most exposed to disruption of China exports of automobile parts and accessories, that is, 11.7 billion U.S. dollars. After USA, Japan experienced 3.2 billion U.S. dollars of China's export disruption. While Mexico, Germany and South Korea experienced a disruption of 2, 1.7 and 1.2 billion U.S. dollars of China's exports.

The overall effect of production stoppage as a result of collapsing demand has major impact on the production rate of global automobile industry. The global auto production is estimated to decline by 16% in academic year 2020 due to COVID-19 pandemic ([https://www.accenture.com/\\_acnmedia/PDF-121/Accenture-COVID-19-Impact-Automotive-Industry.pdf](https://www.accenture.com/_acnmedia/PDF-121/Accenture-COVID-19-Impact-Automotive-Industry.pdf)).

The automobile industry in India, which is the fourth largest industry in the world is facing significant decline as continuous lockdown has affected the production and consumer demands. The following Table 6 illustrates the domestic sales of passenger vehicles, commercial vehicles and two-wheeler vehicles before COVID-19 began and in the month of March after COVID-19 cases reported in India. In the month of March,



**FIGURE 13** Impact of China supply shortage on global auto production**TABLE 6** Comparison of domestic sales of passenger vehicles before COVID-19 began and after COVID-19 cases reported

Category	2019–2020 (before COVID-19 began)	In March (after COVID-19 cases were reported)
Passenger vehicles	6,77,311	143,014
Commercial vehicles	60,713	13,027
Two-wheeler vehicles	35,20,376	866,849

sale of passenger vehicles, commercial vehicles and two-wheeler vehicles has been declined by 51%, 88% and 40%, respectively, according to the data stated by the Society of Indian Automobile Manufacturers (SIAM; <https://www.counterpointresearch.com/weekly-updates-covid-19-impact-global-automotive-industry/>). The production in the last week of March and sales in the month of March are almost zero due to nation-wide lockdown.

By implementing actions in three timelines such as (i) a fast reaction to the present crisis by focussing on the protection of the people, (ii) reformation of new strategic policies to arise as strong industry after the critical situation, (iii) adjustment to new financial phenomenon by reconstructing current activities of the industry may assist the automobile industry in handling the disruption arise due to the supply shortage of vehicle parts and accessories.

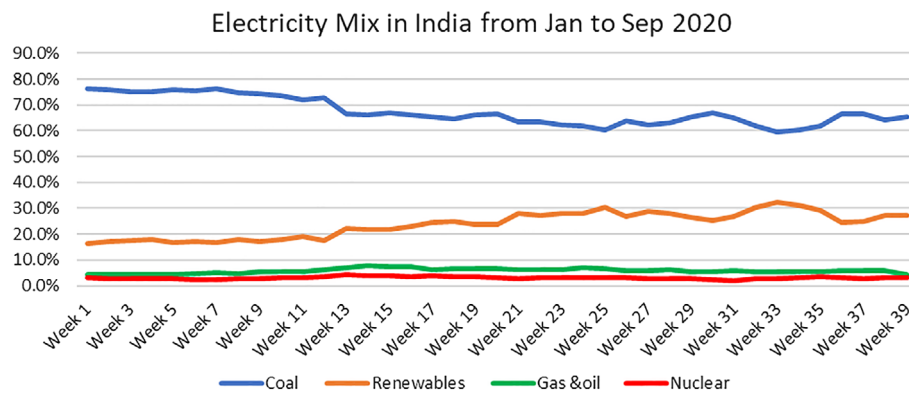
## 9.2 | Analysis on power and energy industry

Due to COVID-19 pandemic, the energy demand pattern in India has been declined sharply. The decline occurred mainly because of the inactivity in the transactions of business, industries, agriculture and other commercial sectors due to continuous lockdown. In industry and commercial sectors, there is a sharp decline in the load demands while in domestic sector and hospital services the load demands have been enhanced slightly. These variations in the energy demand patterns not only created financial stress on the power sector but also imposed lot of socioeconomic and technical challenges to the power sector. During the lockdown in India, the electricity mix has been switched to the renewable source because of the declined energy demand, less operating cost and priority basis access to the grid by means of regulations. Figure 14 represents the electricity mix in India from January 2020 to September 2020 (<https://www.iea.org/reports/covid-19-impact-on-electricity>). After the implementation of first lockdown phase, the breach between coal and renewables has been reduced significantly. From the first lockdown phase onwards, the share of the coal remained consistently below 70% in the power mix. In the last week of May, the share of renewables has been increased as the levels of energy demands were recovered with rising temperatures.

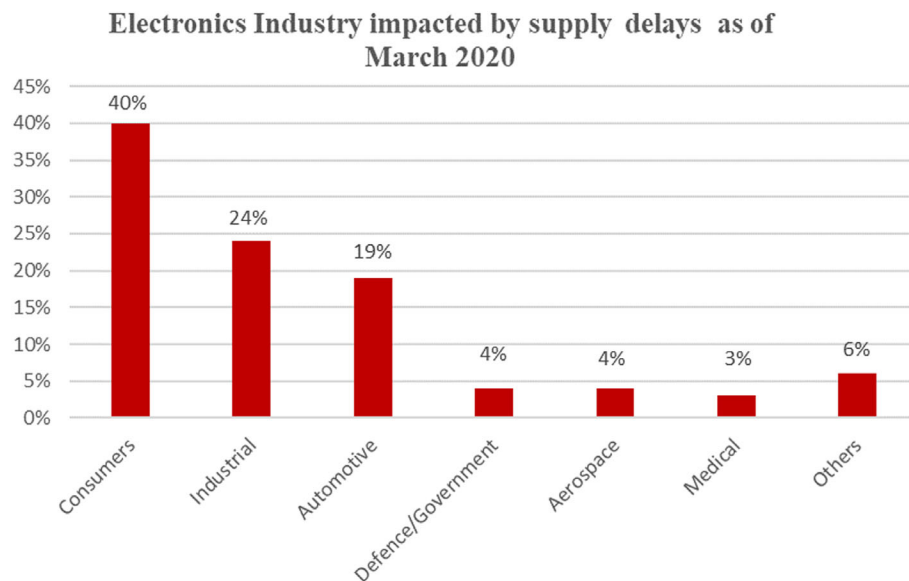
According to the data stated by India's Power System Operation Corporation (POSOCO), there was a total demand of 18 kWh billion units during the first weeks of the lockdown phase while the demand was 23 kWh billion units before 1 week of the lockdown. It indicates a decline of roughly 21.7% energy demand in the first weeks of the lockdown phase. Moreover, the average clearing price has reduced from IR2.15 to IR1.95 per kilowatt hour. To meet the challenges faced by power system, the Indian government has approved a fiscal assistance package for the power distribution companies by granting moratorium of 3 months. Moreover, they have also cutdown the security payment amount to half for power purchases in the future.

## 9.3 | Analysis on electronics industry

The global electronics industry has experienced dual affect due to the outbreak of COVID-19. Due to the lack of workforce and slowdown of logistics, there is a halt in the production of electronic parts all over the world. In addition, the non-functioning of e-commerce companies across



**FIGURE 14** Power mix in India from January 2020 to September 2020



**FIGURE 15** Impact of supply delay on the global electronic industry as of March 2020

the world due to lockdown has adversely affected the electronics industry. In addition to this, COVID-19 has also interrupted the supply chain of significant electronic brands all over the world. China is the world's largest producer and supplier of electronic inputs to several zones of the world. The halt in the production of electronic parts in China due to lockdown has impacted the production of finished goods in U.S. and European countries which results in gap between demand and supply of the electronic parts. Figure 15 represents the impact of supply delays on global electronic industry as of March 2020 (<https://www.statista.com/statistics/1106093/electronics-industries-impacted-by-supply-chain-delays-due-to-covid-19-worldwide>). From the figure it can be observed that 40% of the consumer sector has been impacted due to the supply delay, lack of workforce and shutdown of e-commerce companies. Next highly affected sector is the industrial sector, that is, 24%. Nineteen percentage of the automotive sector is impacted by the supply delay of electronic products. The impact of supply delay of electronic products on Defence/Government, Aerospace and Medical is 4%, 4% and 3%, respectively. These sectors are less impacted when compared with consumers, industrial and automotive industry. The overall impact of supply delay on all other sectors is 6% only.

#### 9.4 | Analysis on transport, travel and tourism

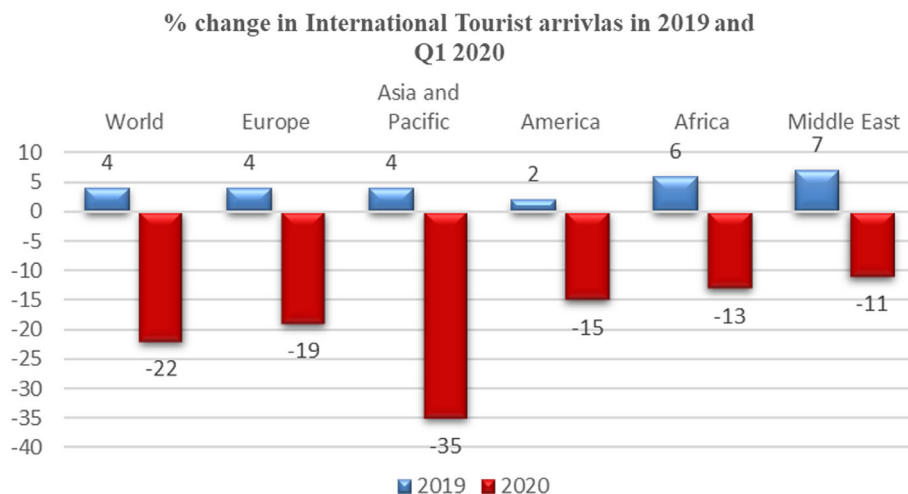
Tourism and travel contributes a significant share of the GDP globally and is considered as the backbone of many country's national income. The loss induced in tourism also impacts the economy of other sectors that produces goods and services to the tourism sector. According to UNCTAD (United Nations Conference on Trade and Development), national income of the country will decline by \$2–\$3 million if there is loss of \$1 million in the revenue of international tourism. Due to the lockdown policies, travel restrictions and closure of international and national airports and

borders, there is a drop of 57% in the tourist arrivals in the month of March according to data stated by United Nations World Tourism Organization (UNWTO). Figure 16 depicts the change in International tourist arrivals in 2019 and first Quarter of 2020. Even though Asia and Pacific shows the highest effect in absolute and relative terms, the effect is somewhat high in volumes in Europe.

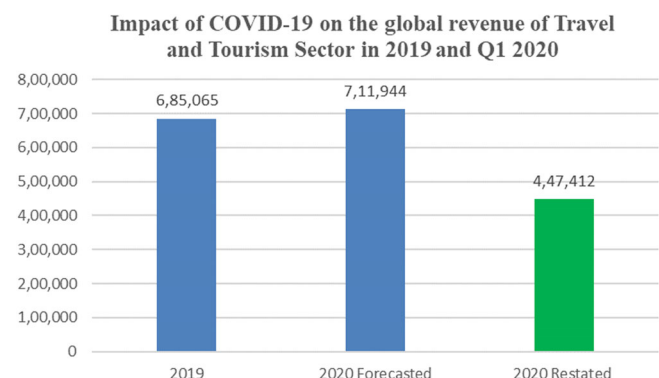
Figure 17 represents impact of COVID-19 on the global revenue of travel and tourism sector in the academic year 2019 and Q1 of 2020 (<https://www.statista.com/forecasts/1103426/covid-19-revenue-travel-tourism-industry-forecast>). The global revenue from travel and tourism sector is estimated as 447.4 billion U.S. dollars in the first quarter of 2020 as per the mobility market outlook on COVID-19. It shows a decline of 34.7% from the revenue generated in the academic year 2019. Moreover, the estimated revenue is also lesser than the original revenue forecasted from travel and tourism sector. This is mainly due to the lockdown of national and international border and the travel restriction policies imposed because of the COVID-19 pandemic.

## 9.5 | Analysis on agriculture industry

In India, the agriculture sector is considered as the main pillar of the economy. This sector not only provides the needs of food consumption but also places itself in the world as the top exporter of agricultural products. In recent period, this sector is also facing the interruption in the agriculture and supply chains due to the COVID-19 outbreak. Due to the lockdown, some disruptions occurred in the harvesting activities especially in the northwest region of India where wheat and pulses are harvested. This is mainly because of the unavailability of migrant labour. In addition, some interruptions have also occurred in the supply chains mainly due to the transportation problems. Figure 18 represents the drop in arrivals of major food items in the week of 1–6 April 2020 when compared with the week of 1–6 March 2020. It represents a decline of 15%–76% in the arrivals of major food items according to the data collected by BloombergQuint from Agmarknet (<https://www.bloombergquint.com/business/in-charts-the-emerging-economic-impact-of-a-nationwide-lockdown>). In the first week of April 2020, the total arrivals of major food items such as cereals, vegetables and fruits fell to 3.09 lakh tonnes when compared to the total arrivals in the first week of March 2020.



**FIGURE 16** % Change in international tourist arrivals in 2019 and Q1 2020



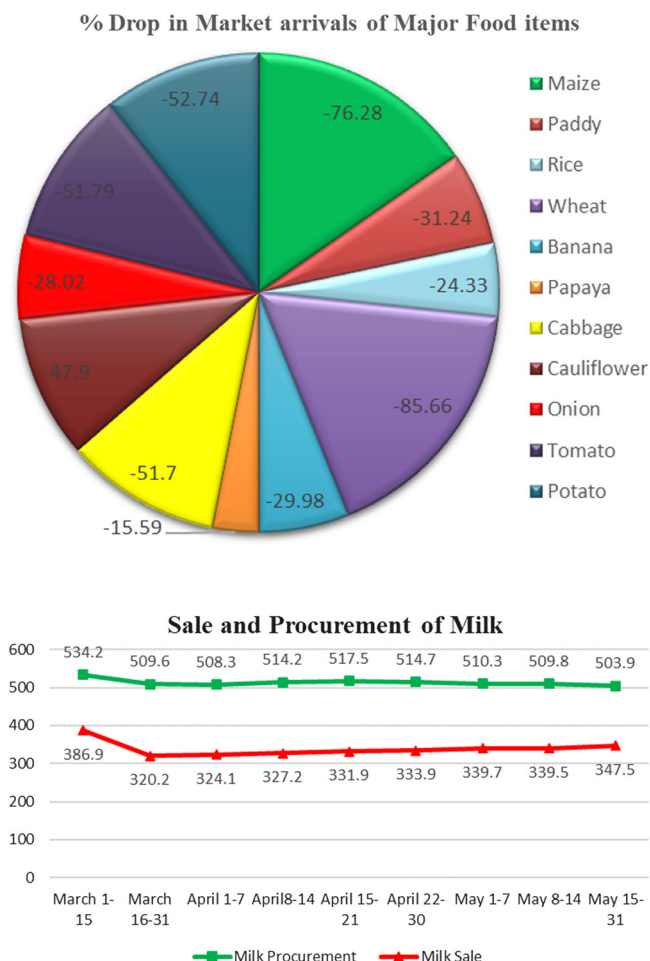
**FIGURE 17** Analysis of COVID-19 impact on the global revenue of travel and tourism sector in 2019 and Q1 2020

Moreover, the sales of milk products have been decreased. This is because of the stoppage of hotels, restaurants, sweet shops and tea shops due to lockdown. Figure 19 represents the procurement and sale of milk from March to May 2020. According to the data stated by National Dairy Development Board (NDDB), the procurement of milk in the first 2 weeks of March 2020 is 534.2 lakh litres per day. The procurement has been dropped to 508.3 lakh litres per day by the second week of April 2020. In the last 2 weeks of May 2020, it has been dropped to 503.9 lakh litres per day. The sale of milk in the first 2 weeks of the March 2020, is 386.9 lakh litres per day. The sales have been dropped to 324.1 lakh litres per day by the second week of April 2020. From the middle of the April 2020, the sales have been increased and reached to 347.5 lakh litres per day by the end of May 2020.

## 9.6 | Analysis on education system

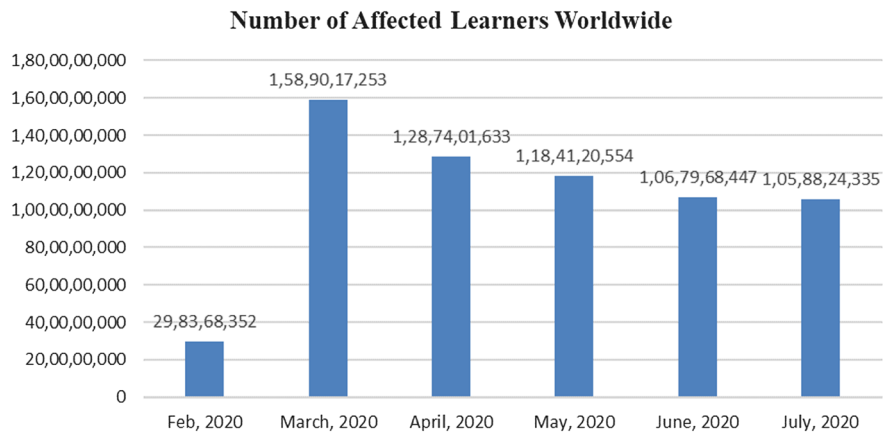
Due to the impact of COVID-19, governments of several countries across the World have temporarily shut down educational institutions to prevent the spread of the infection. Figure 20 depicts the number of affected learners across the world due to the closure of schools from the period February 2020 to July 2020 (UNESCO, 2020) (<https://en.unesco.org/covid19/educationresponse>). From the figure, it can be observed that more no. of learners affected in March 2020 and April 2020 because as large number of countries have been affected due to COVID-19 in this period. In the month of February 2020, it was less as only few countries were affected. From May 2020 onwards, there is decrease in the number of learners affected as the schools have been reopened due to decline in the number of cases in few countries.

Figure 21 represents the country wide closure of schools during the period of February 2020 to July 2020 (UNESCO, 2020). Initially, in the month of February 2020, only few countries announced closure of educational institutions. As number of countries impacted because of COVID-19 in the month of March 2020 and April 2020, large numbers of countries have announced the closure of educational institutions during this period. From the month of May 2020 onwards, the number of cases started decreasing in few countries. Therefore, these countries announced the reopening of educational institutions from the month of May 2020, onwards.



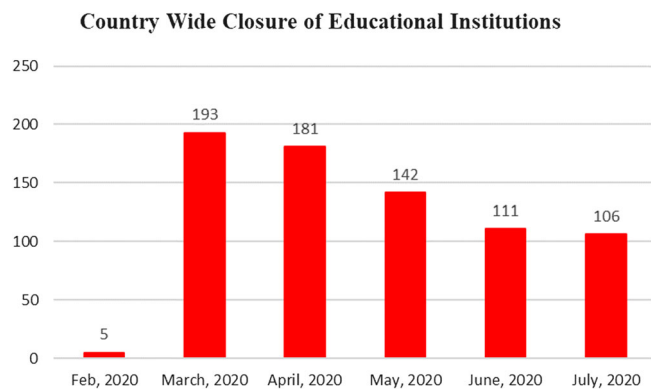
**FIGURE 18** Percentage drop in the market arrivals of major food items due to disruption in supply chain

**FIGURE 19** Procurement and Sale of Milk during the lockdown, that is from March 2020 to May 2020



**FIGURE 20** Number of affected learners world wide

**FIGURE 21** Country wide closure of educational institutions



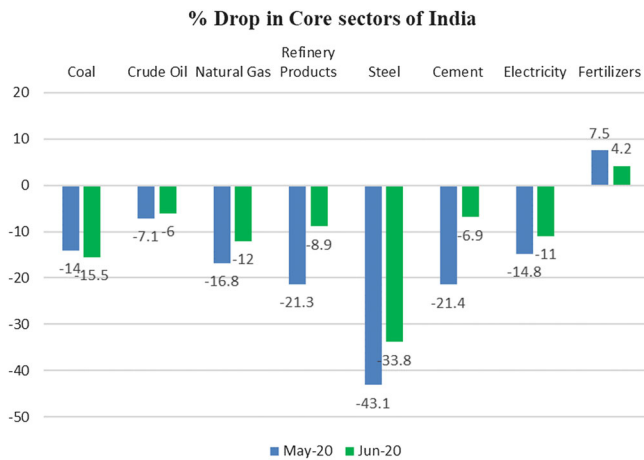
## 9.7 | Analysis on COVID-19 in other sectors

The index of eight core industries in India such as coal, crude oil, natural gas, refinery products, steel, cement, electricity and fertilizers that have 40% weight in the IIP (index of industrial production) also encountered continuous drop in economy. Figure 22 represents the percentage drop in the eight core sectors of India in the month of May 2020 and June 2020. The eight core industries dropped to 22% in the month of May 2020, while it is 15% in June 2020. There is also decline of 33% in the month of April. According to the data stated by the Ministry of Commerce and Industry, the cumulative growth of eight core industries was -24.6% in the year 2020-2021 during the period April to June 2020 (<https://economictimes.indiatimes.com/news/economy/indicators/eight-core-industries-output-contracts-15-per-cent-in-june/articleshow/77283914.cms>).

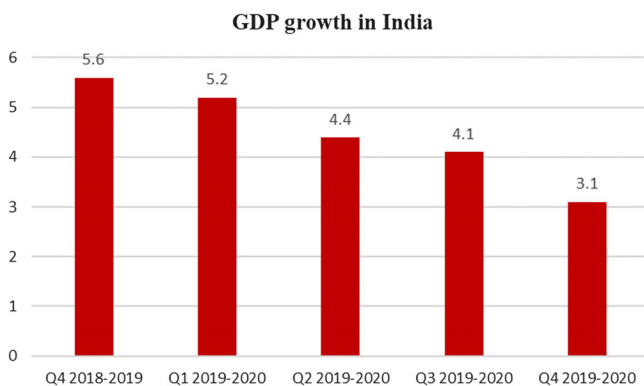
## 9.8 | Overall impact of COVID-19 on the GDP and unemployment in India

Figure 23 displays the growth of GDP in India in the Year 2019-2020 (<https://timesofindia.indiatimes.com/business/india-business/gdp-growth-slows-to-3-1-in-q4-core-sector-output-contracts-38-1-in-april/articleshow/76090944.cms>). From the figure, it can be observed that economy in India slowed down to 3.1% in the January-March Quarter. This is mainly due to the lockdown restrictions and closure of national and international borders which caused disruption in the supply chain of different sectors that contribute to the growth of Indian economy. The Indian economy in Q1, Q2 and Q3 of 2019-2020 stood at 5.2, 4.4, and 4.1, respectively. As lockdown continues, economists assumed that the financial year that begin in the month of April, 2020 will witness the worst contradiction in the economy.

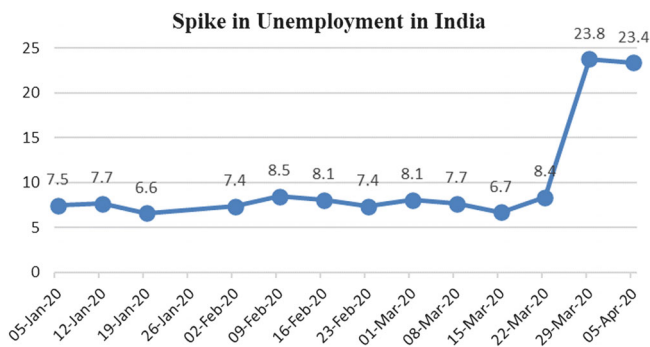
Figure 24 represents the spike in unemployment rate due to the lockdown. The unplanned lockdown announced by the government of India to inhibit the dissemination of virus on 25 March 2020 has kept millions of migrant workers with no job. Also, the disruption in different sectors left many citizens without job in private sectors. From the figure, it can be observed that there is a spike in the unemployment rate in the last week of March 2020 and stayed near to the same levels in the first week of April as per the data collected by the Center for Monitoring Indian



**FIGURE 22** % Drop in core sectors of India in May2020 and June 2020



**FIGURE 23** GDP growth in India



**FIGURE 24** Unemployment rate in India

Economy (CMIE) (<https://www.bloombergquint.com/business/in-charts-the-emerging-economic-impact-of-a-nationwide-lockdown>). To overcome the spike in unemployment rate, the Indian government has announced policies in order to save the life of citizens.

## 9.9 | Analysis of the previous review literatures

The analysis of previous literatures on the COVID-19 effect on the economy of the various sectors in different regions of the world has been represented in Table 7.

Form the above analysis, it is observed that either an analysis of particular sector or overview of different sectors affected due to COVID-19 has been presented. In most of the studies not specified what are the strategies to be taken by the government and policy makers to cope up with disruption occurred in economy has not been specified. By taking inspiration from this fact, in this paper we provided an in-detail description and critical analysis of the impact of COVID-19 on six different industries and its subsectors and also specified the necessary strategies need to be

**TABLE 7** Analysis of the previous literature reviews

Reference	Focused area	Limitations
Gandhi and Gandhi (2020)	Aviation, pharmaceutical, tourism, hospitality and entertainment sector in India	Not covered major sectors that impact the economy of the country
Fernandes (2020)	China's role in world imports, exports and World's GDP, performance of World's stock market and returns of stock market in various sectors, forecast of GDP growth in various countries of the world using different scenarios	Not specified about the disruption occurred in different sectors due to shutdown of borders, delays in supply chain and lock down measures
Nicola et al. (2020)	Agriculture, petroleum and oil, manufacturing industry, education, finance industry, healthcare and pharmaceutical industry, hospitality, tourism and aviation, real estate and housing sector, sports industry, information technology, media, research and development, food sector social impact	Not specified in detail critical analysis of how COVID-19 effected these sectors and what are the strategies taken by the Government and Policy makers to overcome the disruption occurred in different sectors
Ozili and Arun (2020)	Travel industry, hospitality industry, sports industry, oil-dependent countries, import-dependent countries, event industry, education sector, health sector, finance markets, financial sectors, entertainment sector and policy measures introduced by different countries to cope with the impact of COVID-19	No specified in detailed critical analysis of how COVID-19 has affected the economy in different regions of the world in various sectors Specified the analysis of impact of COVID-19 for short period

adopted by these industries and measures and policies provided by the government of countries to cope up with disruption encountered in the economy of these countries.

## 10 | CONCLUSION

The COVID-19 pandemic that encountered in the late December 2019 in Wuhan city of South China, started spreading rapidly from the month of March 2020 in different regions of the world. This COVID-19 Crisis has not only distressed the health of the people all over the world but also created disruption in the social and economic activities of the people throughout the world. When the number of cases started increasing exponentially in different regions of the world, then the government authorities of different countries has announced strict lockdown measures, travel restrictions and shutdown of national and international borders to prevent the spread of the disease. Due to these lockdown policies, a great disruption occurred in the supply chain of different countries which in turn impacted the economy of the country. In this paper, we presented a detailed explanation of the impact of COVID-19 on six different industries such as automobile, power and energy, electronics, travel, tourism and transportation, agriculture and education and its sub sectors which occurred mainly due to the disruption in the supply chains and transportation. Further we have also specified the strategies to be implemented by these industries and measures and policies provided by the government of concerned countries to cope up with the disruption occurred in the economy of the nation. Moreover, we also presented a systematic analysis of how disruption in different industries affected the economy of the countries in graphical representation. Furthermore, an overall analysis of how lockdown affected the GDP growth and unemployment rate in India has also been presented. Finally, this research assists the researchers, policy makers and Government authorities in developing and implementing effective strategies such as immediate relief plan, broad socioeconomic plan for each sector to overcome the disruptions occurred due to the crisis. The review of disruption in other sectors and analysis of the measures and policies taken by policy makers and government authorities to cope up with economy can be considered as further scope of this paper.

## DATA AVAILABILITY STATEMENT

No

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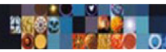
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**How to cite this article:** Nayak J, Mishra M, Naik B, Swapnarekha H, Cengiz K, Shanmuganathan V. An impact study of COVID-19 on six different industries: Automobile, energy and power, agriculture, education, travel and tourism and consumer electronics. *Expert Systems*. 2021;1–32. <https://doi.org/10.1111/exsy.12677>